International PROJECTIONIST

Edited by James J. Finn

July 1934
Vol. 7, No. 1

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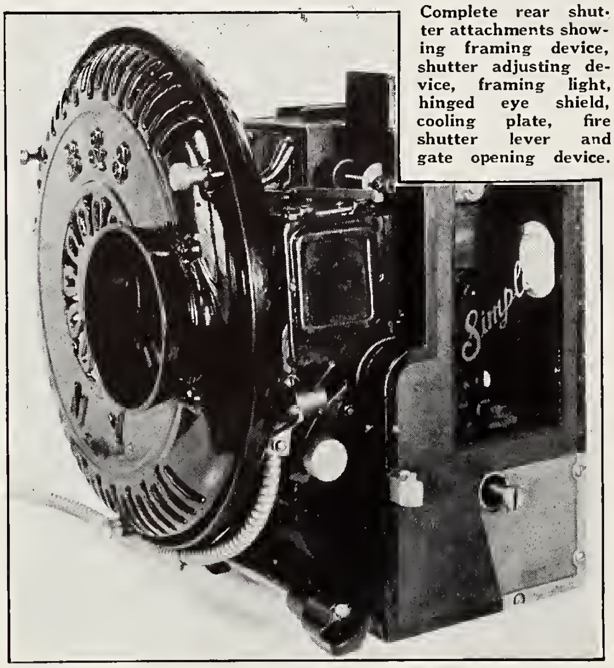

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International PROJECTIONIST

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Edited by James J. Finn

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MONTHLY CHAT

COMING events cast their shadows before. The joust between Chicago Local 110 and the I. B. E. W. outfit as to who has jurisdictional rights over the television equipment now being used at the World's Fair is just a sample of what may be expected in the future. Thus far, the electricians are in front in the controversy.

There seems to be no question that television, when ready, will utilize the projection process, the action to be photographed on film. Of course, from the I. B. E. W. point of view the possession of even an electric ice box without benefit of one of their maintenance men is nothing less than a felony.

IT'S nothing in the projection line, but the news that Paramount will continue through the 1934-35 season its policy of not selling 10-cent theatres is good news for show business generally—projection included.

MR. EARL CARROLL'S much publicised plan to use projected backgrounds for his flesh stage shows is old stuff. The industry trade press went for this Carroll stunt in the biggest sort of way; but any first-class presentation house, having a live projection man, has known and used this stunt for years.

For Mr. Carroll's information, it won't work out.

THREATS of suspension of film service have recently been utilized to force exhibitors into line with Code Authority decisions. This same tenacity applied to labor provision compliance, following regional board decisions, would make for happier relations all around and prevent such conditions as exist in New York, in Kansas City and elsewhere.

WITHIN another month no less than three new 50-ampere D. C. projection lamps will make their bow. Using the new Suprex carbons, these new lamps will eliminate any possible excuse for poor screen illumination. Even on the ground of economy there can be no argument, for the savings in current and carbons effected by these lamps will amortize a goodly portion of their cost within a year.

Those now using low-intensity or hi-low lamps might well pay particular attention to this new equipment.

IN A cooperative ad. in *Variety* projectionists at the State-Lake Theatre, Chicago, are listed under the heading, "Kino Booth". We relish this choice addition to projection nomenclature, and hope that five years is not too long to wait for these State-Lake orchids to discover the term, "projection room".

INTERNATIONAL PROJECTIONIST

VOLUME VII — NUMBER 1

JULY 1934

MATHEMATICS FOR THE PROJECTIONIST

Gordon S. Mitchell

Lesson IX. General Review

IN CONCLUDING this series of mathematics for the projectionist, we will in this lesson review the subjects of logarithms, the slide rule, and the fundamentals of algebra,—the subjects of addition, subtraction, multiplication and division requiring no further review. In the next and final lesson, we will review the general subject of equations, the solution of simultaneous linear equations, the use of graphs and curves, and the solution of quadratic equations.

Logarithms take their importance mainly from the fact that the fundamentals of the design and operation of the slide rule, are based upon logarithmic principles. A logarithm is subdivided into two parts—the *characteristic*, which is that part of the logarithm to the left of the decimal point, and the *mantissa*, which is that part of the logarithm to the right of the decimal.

While the mantissa is based wholly upon the combination of figures making up the number under consideration, and is obtained from the log tables, the characteristic is entirely independent of the actual figure under consideration, and is based upon the number of *whole numbers* there are in that figure.

For example, the figure 4,345 has four whole numbers, and the characteristic of the log of 4,345, (determined as one less than the number of whole numbers in the figure) would be 3; the characteristic of the log of 547,909 would be 5, while the characteristic of the log of 18 would be 1.

To briefly recapitulate the fundamental logarithmic operations:

(1) To multiply two numbers together, we add their logarithms, and the anti-log of the sum is the product of our multiplication. (When we have a number which we know to be a logarithm, and wish to determine the figure of which our number is the logarithm, we determine the figure from the log tables by exactly the reverse operation of finding the logarithm of a number,—the figure so obtained being known as an "anti-log".)

(2) To divide two numbers, we subtract their logarithms, and the anti-log of the difference is the answer to our division problem.

(3) To obtain any desired root of a number, we divide the logarithm of that number by the root index, and the anti-log of the quotient is the desired root.

(4) To raise any number to any desired power, we multiply the logarithm of that number by the exponent, and the anti-log of the product of that multiplication is the correct result.

In working out short-cuts for mathematical operations, mathematicians have devised multiplication and division scales, log tables, trigonometric tables, and various types of slide rules. Of the many types of slide rules, the projectionist should have at least a working acquaintance with the log slide rule (based upon logarithmic tables) the type rule most commonly used by engineers.

The slide rule consists essentially of two scales, placed so that one will slide upon the other. Although the ordinary inch scale with which we are all familiar is marked off in such a way that consecutive integers are placed equidistant from each other along the length of the scale, on the slide rule the scale is so marked that the distance between each consecutive integer decreases towards the right—the distance between each being based upon a logarithmic scale. Contrasted to the ordinary measuring scale, which begins at zero, the scale on the slide rule begins at 1.

The slide rule is a specialized and

particular tool, and unless the projectionist possesses one with which to experiment, there is little point in studying the device in detail other than to glean a general knowledge of what may be done with it. Those particularly interested in it are referred to the December, 1933, issue of INTERNATIONAL PROJECTIONIST.

Algebraic Equations

The fundamental difference between algebra and arithmetic is that in algebra we deal with *letters,* while in arithmetic we deal exclusively with *numbers.* In algebra, the letters with which we deal may represent either whole numbers, fractions, or decimals, and the various arithmetic operations are performed upon these letters rather than upon the numbers they represent.

Although the following problem is of the simplest type, it will illustrate the method by which an algebraic problem is solved: If we have a series resistance circuit, made up of two resistances, of which we wish to know the total resistance, we would let "X" equal the total resistance of the circuit. The resistance of one arm, which we know to be 7 ohms, we would set equal to "R", (thus, wherever the letter R appeared, it would have a value of 7); and to the other portion of the circuit, having a resistance of 12 ohms, we would assign the letter "S". Thus we have the rudiments of an algebraic equation in its simplest form:

$$X=R+S,$$

in which the total resistance is equal to the sum of the resistance of each part.

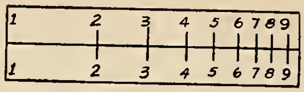
$$X=7+12=19 \text{ ohms}$$

The use of algebra to solve such a simple problem is, of course, unnecessary, but in many cases the solution will lend itself to algebraic methods where ordinary arithmetical means would be extremely difficult, if not impossible.

Algebraic symbols may be added, subtracted, divided, multiplied, and raised to any power, or any root may be extracted therefrom. In many cases, the arithmetic operation may be only indicated, inasmuch as we may not add *a* to *b* to obtain any other expression than "a+b" any more than we may add two screens to three apples to obtain anything other than two screens and three apples. However, we may add "b" to "2b" to obtain "3b" just as we may add 2 screens to 5 screens to obtain 7 screens.

In the expression 3b above, the number 3 is known as the *coefficient* of b, for the reason that *b* in the expression is taken three times. Similarly, if we have the expression "rb", the "r" is the coefficient of b, meaning that in that particular case the *b* is taken "r" times.

A coefficient may be a whole number (27b); a series of letters (xrb); a common fraction ($\frac{1}{4}$b), or a decimal fraction such as .87b. It is common algebraic practice, if no coefficient is expressed, to assume a coefficient of 1.



Conventional slide rule

As previously stated, algebraic symbols may be either added, subtracted, multiplied, divided, raised to a power, or have a root extracted. However, in an algebraic problem, a certain order of procedure has been specified which if not followed will give an incorrect result.

In other words, if we have a long problem in which division, addition, subtraction, etc., are indicated, in order to obtain the correct result we must first go through the problem and do all of the indicated raising to powers and extraction of roots; then all of the multiplication and division, and, finally, all of the addition and subtraction.

To illustrate, we will go through a problem in which some of these operations are to be performed, such as:

$$7+2\times3+8^2-\sqrt{4}+6\div3=$$

Following out our order of procedure which says that we must first perform all raising of powers and extraction of roots, we will square the 8 and extract the square root of 4, after which our problem becomes:

$$7+2\times3+64-2+6\div3=$$

Next completing the indicated multiplication and division, we obtain

$$7+6+64-2+2=$$

Which gives us an answer of 77, after the addition and subtraction have been made.

Parentheses are often used in algebra to indicate that the operations are *not* performed in the usual sequence—the rule in this case being to perform all of the operations *within* the parentheses first, then to follow the correct sequence from that point on.

In other words, if we have an expression such as:

$$5\times9+4(3+2^2)$$

Alliance Takes Over Local 306 For Second Time Within Two Years; Harry Sherman Resigns

CONTROL of Local Union 306 (N. Y. City) has been taken over by the International Alliance for the second time within two years. All Local officers will retain their posts, with the exception of Harry Sherman, who resigned (23) to "enable the I. A. to exercise a free hand". H. Holmden, B. A. of Cleveland Local 160, is temporarily in charge of 306.

The I. A. last took over the affairs of Local 306 in November, 1932, and at the same time removed 20 officers of the Local, following an exhaustive investigation of 306 matters by the General Executive Board. Immediately thereafter Sam Kaplan, deposed president, began a series of court actions to test the right of the I. A. to remove him, which only recently produced a verdict favorable to the latter.

Subsequently Kaplan was convicted of coercion against 306 members and is now in the penitentiary serving a six-month-to-three-year sentence for this offense. The attitude of the present 306 officials is one of cooperation with the I. A., and no trouble is expected.

The troubles which beset Local 306 include a continuation of the internal strife among its 1,800 members, which movement is said to have its center in the so-called Kaplan faction; a bitter battle by 306 against two other projectionists' union (Empire and Allied, the latter having been adjudged a "company union"); severe unemployment; the continuing offensive against the Union by the theatre owners (I.T.O.A., which comprises virtually all the independent owners in the city), and last but by no means least, the manifest impotency of the NRA to enforce the provisions of the motion picture code labor sections, New York exhibitors being permitted to do any and everything they please, including firing men and cutting salaries and manpower, despite a series of Regional Labor Board and N. Y. Supreme Court decisions against them.

NRA Impotency Demonstrated

In New York City, which offers employment to about 1,900 projectionists, there are more than 5,500 licenses currently in effect, not a few of which are held by I. B. E. W. members. Having 1,200 members in the summer of 1933, Local 306 was induced to take in some 600 "permit men" by Edward F. McGrady, then representing the A. F. of L. and now Assistant Secretary of Labor, who promised that the NRA code would "take care of manpower problems." It didn't; but on the contrary permitted labor practices by exhibitors which contributed to the 306 manpower worries.

Nowhere in the country was the impotence of the NRA compliance machinery more graphically shown than in New York City, where three distinct mobs of pickets have been roaming the streets for about a year.

The I. A. has not announced its policy with respect to 306, but for the present all meetings have been discontinued and President Browne is not saying when he will restore local autonomy.

and were we not to follow the rule of first completing the operations within the parentheses, we would square the 2, then doing the indicated multiplication, would multiply our 5x9 and our 4x3, to obtain an expression—

$$45+12+4$$

which would give us an answer of 61.

However, if we correctly follow the rule to perform all operations within the parentheses first, we square the 2 and add the resulting 4 to the three within the parentheses, to obtain an expression

$$5 \times 9+4 \times 7, \text{ or}$$
$$45+28,$$

which is 73, the correct answer.

It can be seen that the incorrect answer was obtained because *we did not follow the rule of first completing all operations within the parentheses.*

In adding positive and negative numbers together, all the negative numbers are added together, and all the positive numbers added together, after which the smaller sum is *subtracted* from the larger —the final result taking the sign of the larger of the two sums. This rule is important, because upon it is based the entire procedure of algebraic subtraction.

When we subtract one algebraic expression from another, we change the signs of all of the terms of the *subtrahend* (that being subtracted) and then add.

For example, consider the expression $(7a+5a-6b)$ and subtract it from the expression $(9a-5a-9b)$. Remembering the rule which states that all operations within the parentheses must be performed *first*, we simplify our two terms by adding the 7a and the 5a in the first to obtain 12a, making the expression $(12a-6b)$, the second becoming, after similar simplification, $(4a-9b)$.

Changing the signs of all terms in the subtrahend, this becomes $-4a+9b$, and we then add:

$$12a-6b-4a+9b,$$

to obtain an answer of

$$8a+3b$$

This result is in its simplest terms, of course, because, as was pointed out previously, it is impossible to add two unlike terms to obtain an expression simpler than the statement indicating the addition—*i.e.*, two screens and three apples.

In dealing with the multiplication and division of positive and negative numbers, there are only two fundamental rules which must be kept in mind:

(1) That when two terms of an algebraic expression with *like* signs (either both positive or both negative) are multiplied or divided together, the result will be *positive*.

(2) That when two terms of an algebraic expression with *unlike* signs (one positive and one negative) are multiplied or divided together, the result will be *negative*.

A specialization of these rules which should be remembered is that the even powers of any number or letter (the second, fourth, sixth, eighth, tenth, twelfth, etc.) whether that number or letter be either positive or negative, will always be *positive*.

The odd powers, however, (third, fifth, seventh, ninth, eleventh, etc.) will be positive if the original number be positive, and negative if the original number be negative.

In other words, if we square (raise to the second power) either -3 or $+3$, we obtain $+9$; but if we cube (raise to the third power) -3, we obtain -27; while cubing $+3$ gives us $+27$.

Questions

1. Define the two parts of a logarithm.
2. Explain how a number may be raised to a power by the method of logarithms.
3. What gives the subject of logarithms their principal importance?
4. Solve the following problems, performing the indicated operations in their correct order:

(a) $5+7+3 \times 2 \times 4+6^2-2^3+\sqrt{4}=?$

(b) $61-5^2+7 \times 8=?$

(c) $8-5 \times 3+(6+2^2+1)=?$

(d) $\sqrt{(4+5 \times 2)}+11=?$

5. Subtract:
$21y+18b-17$ from $27y-7b+3$
6. Multiply:
-7 times 6; -4 times -5; 9 times 8
7. Divide:
81 by 9; 56 by -8; -44 by -8
8. Perform the following:
Cube -5; Square 4; Raise -2 to the fifth power; Raise -2 to the fourth power; Extract the square root of 16.

(Answers to above on page 19)

PRE-FIXING NEEDED TO AVOID NEW FILM DAMAGE

Trevor Faulkner

S. M. CHEMICAL COMPANY, INC.

THE photographic emulsion on newly developed film is very soft and therefore it is easily abraded. In order to have a steady image on the screen during projection, it is necessary that the film be held firmly over the aperture plate. Therefore, the film passes between the aperture plate and tension shoes, one on each the right and left sides of the aperture plate.

The tension shoes are similar in construction to the runners of a sled and the amount of tension applied to the film is controlled by spring pressure which can be varied by adjustment. A similar condition also prevails at the sound gate.

In the projectors almost universally used the tension shoes are held against the celluloid side of the film and the emulsion side is held firmly against the tracks of the aperture plate; also against the sound gate in the sound head.

Since the aperture plate has the "spot" of the projection lamp concentrated on it and is stationary, it becomes heated to a relatively high temperature during the ten or eleven minutes required to project the average reel of film.

Emulsion Depositing

New film, not specifically treated, will leave a deposit of emulsion on the tracks of the aperture plate as it passes over them. This deposit soon bakes to a hardness sufficient to seriously damage the remaining portion of the film. This deposit has an action similar to that of a diamond glass cutter, since its "bite" into the film passing over it yields an added tension that may offer such a resistance to the free passage of film as to cause the teeth of the intermittent sprocket to pull or tear the perforations as it propels the film past the aperture.

An emulsion deposit on the tracks at the sound gate will scratch the film as it does at the aperture plate; but a more far-reaching consequence is its interference with the necessary "direct right angle seat" of the film across the light beam as it passes from the exciter lamp to the photo-cell thereby disturbing the proper transmission of sound.

"Motor boat" noises often result from such emulsion deposits at the sound gate because of the altered alignment of the film's passage; also the focus of the light beam is disturbed by the altered angle of the film seat on the sound gate or valve.

Scratches or 'Rain'

The emulsion of new film will become scratched if brought into contact with any stationary dirt or grit or any part of the projector that has roughened surfaces, even of the slightest degree, or in rewinding the film for ensuing screenings, or in exchange inspection; unless it has previously been specifically treated to protect it.

These scratches mar the screen presentation of the picture by the "rainy" effect in the projected image. Each scratch

(*Continued on page* 25)

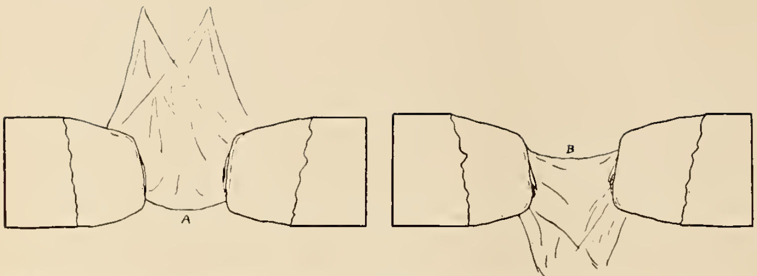


Fig. 2. 8-mm. a-c. high intensity carbons, underloaded: 60 *amperes*, 24 *volts; showing different positions of the arc as it "flops" about on the ends of the carbons*

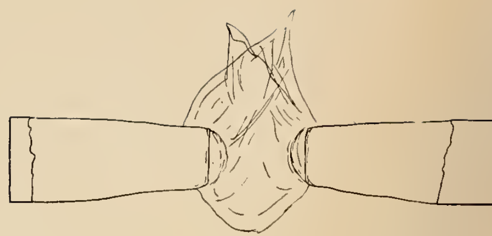


Fig. 1. *8-mm. a-c. high-intensity carbons, overloaded*: 90 *amperes*, 35 *volts*

OPERATING CHARACTERISTICS OF THE NEW A. C. ARC

D. B. Joy* and *E. R. Geib

THE new high-intensity a-c. arc was first discussed before the S.M.P.E. at the Spring, 1933, Meeting[1] at New York, and additional data[2] were given in connection with another subject at the Fall Meeting of the same year at Chicago. Subsequently it was the subject of much consideration by the Projection Practice Committee. The writers contributed to the discussion and were later asked to put their comments in written form as it was felt that this information would be of value to both the users of the high-intensity a-c. arc and the equipment manufacturers.

The aforementioned papers[1,2] gave a general description of the arc, the current and voltage ratings of the carbons, and approximate consumption rates. This is summarized in Table I.

A number of lamps and auxiliary equipment for using the a-c. high-intensity arc have recently appeared on the market and have been installed in a number of theatres. For that reason, a more detailed description of the arc and its operating characteristics will be helpful to those responsible for the operation of such equipment.

The high-intensity a-c. projection arc is essentially a high current-density, low-voltage arc. At the rated currents the current density (970-1090 amps. per sq. in. of carbon cross-section) is very much higher than that of the mirror arc carbons (140-188 amps. per sq. in.), and somewhat higher than even that of the high-intensity d-c. positive carbons (450-900 amps. per sq. in.).

Another difference is that in the conventional d-c. high-intensity lamp the positive carbon is gripped at a point close to the arc, whereas in the a-c. high-intensity lamps both carbons are clamped near the holder end. It is therefore necessary to increase the conductance of the electrode by coating it with metal, which in this case is copper. The copper does not enter the arc stream, its only function being to furnish a low-resistance path for the current from the carbon holder to a point near the arc.

By carefully observing the high-intensity a-c. arc in operation, it will be seen, as shown in the accompanying illustrations, that the copper coat ends an appreciable distance from the arc. As the carbons are consumed the copper coat continually melts away, so that it never is sufficiently close to the tip of the carbon to enter the arc stream itself.

This copper coat is designed to take care of the current rating of the carbon. If the current is too great, the copper will melt to a considerable distance from the arc, as shown in Fig. 1. The arc then becomes unsteady and is apt to blow out, and the arc voltage and consumption of the carbons are increased to such an extent that they may be outside the range of control of the arc-feeding mechanism.

If, on the other hand, the current is too low, the copper will not melt away as far from the arc, the light will be very much reduced, and the current and voltage will not be constant. This condition results in an unsteady arc, which "flops" from the top to the bottom of the carbon, as illustrated in Figs. 2 (*A*) and 2 (*B*).

If the current and voltage limits recommended in Table I are observed neither of these undesirable conditions will be encountered.

The illustrations of the arcs shown in this paper are all traced from actual arc images, and show the true relationship between the different parts of the arc.

Arc Length Important

It is essential for good operation of the arc and good light projection that the high-intensity a-c. arc be maintained within certain definite arc lengths and that it have a characteristic shape which is easily identified. Fig. 3 shows the high-intensity a-c. arc burning under the correct conditions at 80 amperes and 25½ volts between two 8-mm. carbons.

The copper coats end 0.35 inch (8.9 mm.) from the ends of the carbons. The arc length is 0.27 inch (6.9 mm.) long. The end of the electrode is 0.225 inch

TABLE I

Characteristics of Copper-Coated A-C. High-Intensity Carbons

	8-mm.	7-mm.
Current (Amperes)	75-80	60-65
Approximate Arc Voltage	24-29	23-26
Consumption (Inches per Hour)	4.0-5.5	4.0-5.5
Current Density (Amps. per Sq. In.)	970-1040	1000-1090

[1] JOY, D. B., AND DOWNES, A. C.: "A New Alternating-Current Projection Arc." *J. Soc. Mot. Pict. Eng.*, XXI (Aug., 1933), No. 2, p. 116.

[2] JOY D. B., AND DOWNES, A. C.: "Direct-Current High-Intensity Arcs with Non-Rotating Positive Carbons," *J. Soc. Mot. Pict. Eng.*, XXII (Jan., 1934), No. 1, p. 42.

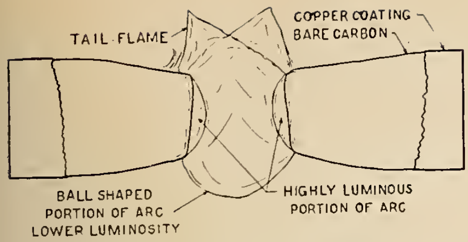


Fig. 3. 8-mm. a-c. high-intensity carbons: 80 *amperes*, 25½ *volts; good operating conditions*

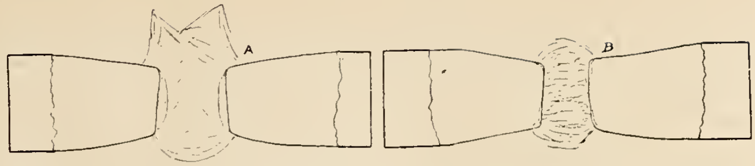


Fig. 5. 8-mm. a-c. high-intensity carbons: 80 *amperes*, 23 *to* 24 *volts*; (*A*) *short arc length, good operating conditions*; (*B*) *short arc length, poor operating conditions*

(5.7 mm.) in diameter. The arc itself consists of a highly luminous portion close to each electrode, and a portion of lower luminosity almost the shape of a ball extending about as far below the electrodes as above them and ending at the top in two well-defined short tail-flames.

It is interesting to note that the shape of the highly luminous portion of the arc near the electrodes approximates the shape of the intrinsic brilliancy curve across the electrode face, which was presented in an earlier paper[1] and is reproduced in Fig. 4. This highly luminous portion of the arc close to the electrode decreases in size as the current is decreased, and becomes very small at the lower current-densities, as illustrated in Fig. 2. This result gives, of course, a much lower intrinsic brilliancy curve and less light on the projection screen.

If the arc length is decreased it will hold essentially the same arc shape; if the operating conditions are favorable, until it reaches approximately 0.23 inch (5.8 mm.), or 24 volts. Fig. 5(*A*) illustrates the arc just before that point, with a good burning condition; and Fig. 5(*B*) the arc just after that point, with a shorter arc length and poor burning conditions.

When the arc length is 0.23 inch (5.8 mm.) the arc stream begins to be turbulent. The two tail-flames and the highly luminous portion of the arc close to the electrodes lose their identity, and the whole arc assumes a boiling and seething appearance. There is rapid flicker; the arc voltage and current are erratic; and in addition, at such very short arc lengths there is a noticeable shadowing effect from the electrodes themselves.

If the length of the arc is increased beyond that shown in Fig. 3, the form of the arc will be sustained if the operating conditions are suitable, until the length is approximately 0.35 inch (8.9 mm.).

Fig. 6(*A*) shows the arc immediately before, and Fig. 6(*B*) after, such a point has been reached. At and beyond that length the arc has a tendency to be swept upward, so that the lower part no longer bows down appreciably and the upper part and the tail-flame become greatly extended. The highly luminous portion close to the electrode likewise becomes distorted, as shown in Fig. 6(*B*). The arc is unstable to such an extent that it will repeatedly jump back and forth between the positions shown in Figs. 6(*A*) and 6(*B*).

Another arc condition that must be considered and if encountered, corrected, is shown in Fig. 7. The arc is of medium length, and would ordinarily have the appearance of Fig. 3, but is disturbed by external forces so that it appears very much like Fig. 6(*B*), and has the tendency to snap back and forth between that position and the one shown in Fig. 3, causing variation of the current and voltage, flicker, and uneven light distribution.

This condition may be caused by too strong a draft in the lamp, or by an unbalanced magnetic effect due to a poor arrangement of the current leads; or by other means that would tend to distort the arc.

If we assume that the design of lamp house, the draft, and the arrangement of leads are such as to avoid the above conditions, the 8-mm. high-intensity a-c. carbons at 80 amperes will exhibit good burning characteristics for arc lengths between 0.23 inch (5.8 mm.) and 0.35 inch (8.9 mm.), and from approximately 24 to 29 volts. There will, however, be a noticeable change of light intensity between those extreme limits, so that the permissible range of variation in arc length and voltage from moment to moment is much less than the complete range of satisfactory performance. This is discussed in greater detail subsequently.

The limits of arc voltage, as ordinarily measured at the incoming leads, will vary slightly depending upon the length of spindle of the carbons, the lengths of the carbons in the holders, and the resistance of the holders themselves.

At 75 amperes the arc lengths that will give good burning characteristics with the 8-mm. carbons are essentially the same as those for 80 amperes, and the arc voltage is approximately one volt lower. The 7-mm. high-intensity a-c. carbons are rated from 60 to 65 amperes. The corresponding conditions for good operation are an arc gap of 0.21 inch (5.3 mm.) to 0.31 inch (7.9 mm.), and an arc voltage of approximately 23 to 26 volts.

The action of the high-intensity a-c. arc under various conditions has a direct bearing on the limitations of the mechanism for feeding the carbons. From the considerations discussed above it is apparent that such a mechanism must be able to feed the carbons at a rate up to 5.5 inches per hour; depending, of course, upon the current passing through the arc. It must also prevent the arc gap from varying more than 0.10 inch (2.5 mm.) or 0.12 inch (3.0 mm.); or, in terms of voltage, it must prevent the arc from varying over a range greater

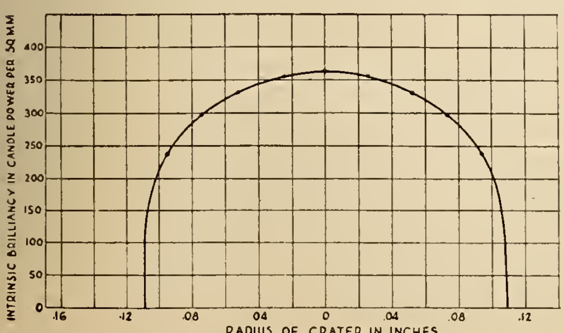


Fig. 4. Intrinsic brilliancy across crater face: 8-*mm. a-c. high-intensity carbons*; 80 *amperes*, 25½ *volts*

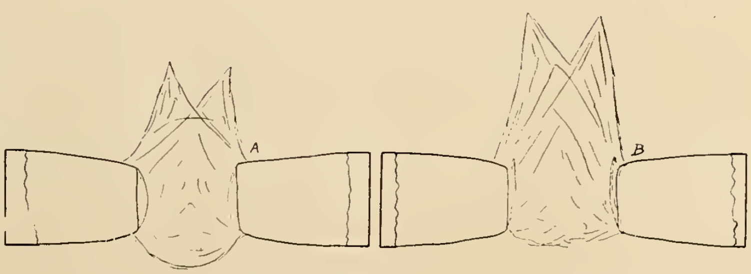


Fig. 6. 8-mm. a-c. high intensity carbons: 80 *amperes*, 28 *to* 29 *volts*; (*A*) *long arc length, good operating conditions*; (*B*) *long arc length, poor operating conditions*

than 3 or 5 volts for the 7-mm. and 8-mm. carbons, respectively.

These are the outside limits, for in order to utilize the total ranges the mechanism would have to be adjusted so that the average position of the carbons would be exactly at the center of the permissible variation.

It must also be borne in mind that if the arc length varies in either direction much beyond the limits of good operation, the current and voltage become erratic and swing through a considerable range. If the feeding mechanism is controlled by either the current or the voltage the above action causes a sudden change in the rate of feeding that is not desirable.

Feed Adjustments

It is not practicable to adjust the feeding mechanism so that it will operate exactly at the center of the permissible range, nor can it be expected that other conditions might remain sufficiently constant to keep it exactly in that position. It is therefore necessary that the mechanism be designed to feed the carbons within a variation much less than the theoretically allowable limits. The narrower the range, the easier it is for the projectionist to maintain the lamp adjustment within the limits of satisfactory arc operation, and maintain a uniform intensity of screen illumination.

These narrow limits for maintaining the arc length presented a real problem, but through close cooperation between the National Carbon Company and the manufacturers of projection equipment the desired results have been accomplished.

In the paper[1] previously cited, it was mentioned that the high-intensity a-c. arc can be operated in series with a suitable resistance unit from the power line, but that for practical reasons a resistance is never used. A transformer and reactor are used instead.

The transformer gives an electrical efficiency of 90 per cent or more, a figure that can not be equaled when ballast resistance is used. The reactor is usually the leakage reactance of the windings of a "high-reactance" transformer. It is desirable that the reactance be kept comparatively low, in order to maintain a reasonable power factor. On the other hand, it must be high enough to assure sufficient stability so that the arc may not be extinguished by ordinary drafts at the longest desirable arc length.

Tests have shown that a 40-per cent reactance will afford sufficient stability to the arc. In other words, if the no-load voltage on the secondary of the transformer is about 40 per cent higher than the load voltage, there will be sufficient stability of the arc for ordinary applications. Additional reactance would improve the factor of safety, but above a no-load voltage of about twice the load voltage, the effect would not be noticeable.

A lower reactance could be used and the results might be satisfactory in most cases, but any advantage achieved in reducing the reactance would not be worth the risk of an "outage".

Another important factor in the design of a transformer for use with the high-intensity a-c. arc is the possible variation of line voltage on different installations. The transformer should be provided with suitable taps, or other means, so that it can be adjusted for the average line voltage of the theatre in which it is installed. If the line voltage at the theatre should vary appreciably, convenient means should be provided for the projectionist to change the transformer taps and so regulate the secondary voltage.

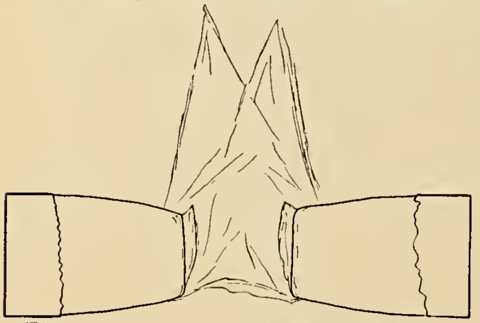


Fig. 7. 8-mm. a-c. high-intensity carbons: 80 amperes, 26 volts; medium arc length, arc disturbed by external forces.

Standardization in Studio and Theatre Aim of S.M.P.E. Sound Committee

Abstracts from Report of the Committee to Spring, 1934, Meeting

IN A communication addressed to the Chairman of the Committee by President Goldsmith the Committee was asked " . . . to formulate standards of sound recording and reproduction (audio-frequency characteristics) of such a type that the producing studios and the theatre circuits can all agree to accept them at a reasonably early date after the standards shall have been agreed upon.

"The present state of sound recording and reproducing indicates that the matter is definitely urgent. There is an unnecessary amount of deviation in releases from the various studios, and it is obvious that the full advantages of improved methods of reproduction can not be realized under the present conditions. Such standardization is the most important problem facing the Committee."

In order to attack the aforementioned problems, it was thought advisable to establish two major sub-committees of the Sound Committee, one of the sub-committees to be representative of the East Coast and the other of the West Coast . . .

On April 12th, the East Coast Sub-Committee met and the discussions and conclusions that were reached were, it is believed, of particular significance to the Society and to the motion picture industry in general. The first question considered was, "Is it agreed that frequency characteristics measured in current or power are a measure of quality?"

In answering the question, the Committee agreed that "in a linear, flutterless, noiseless system, frequency range measured in current or power is one factor that determines quality." It was agreed that for the purpose of study by the Committee, the sound system should be divided into not less than four sections:

(1) Acoustics of the stage and characteristics of the microphone.
(2) From the output of (1) to and including the release print.
(3) From the release print to the input of the loud speaker.
(4) From the loud speaker to the ear.

One of the most difficult tasks was to determine a starting point for the discussion. It was the consensus of opinion, however, that a standard for determining frequency characteristics should be established. It was agreed that frequency characteristics should be measured in terms of calibrated prints of frequency film, this print corresponding to release prints.

Special Print Available

A print is being prepared, to be independently calibrated in the Bell Telephone Laboratories and in the laboratories of RCA Victor Co., which, when completed, will be kept in the offices of the Society as a reference standard.

Data will be available in the S. M. P. E. office regarding the measuring circuits employed in calibrating the film, and the methods of making comparisons with sub-standards. This film will be available to studio personnel for use in calibrating secondary standards.

An attempt will be made, by the time of the next meeting, to obtain data on the frequency characteristics being used in the several recording studios in the East. These data will serve as a basis of discussion of present practices and methods followed in determining the characteristics now employed.

It is the aim of the Sound Committee to lay a foundation for one, two, or even five years' work, if necessary; and to formulate a plan so that at the comple-

tion of the program, systematic coordination between the production studio and the theatre can be achieved.

Discussion:

MR. SPONABLE: I received one of the first copies of the Standard test reel devised by the Projection Practice Committee, and have been using it almost constantly since the time I received it. There is an indication that the reel is gradually changing as a standard of frequency, also as a standard of sound quality. The Committee should investigate the question of how long a standard would remain a standard for frequency and speech and quality.

MR. DAVEE: When the films that we propose to make are calibrated, the circuits that are employed in the calibration will be in the Society's offices. Both the RCA Victor Company and the Bell Telephone Laboratories will calibrate the same film, and if a difference is found to exist between the calibrations, it will have to be eliminated.

When the circuits are submitted to the Committee, it is expected that they will not differ so much as to forbid a satisfactory correlation between the two, and a standard measuring circuit will be arrived at so that we can check the frequency of the standard film from time to time to find out whether it has deteriorated or not.

We do not particularly care what that frequency characteristic is; it can be anything, so long as we know what it is and can check it from time to time.

MR. KELLOG: The calibration of such a film involves not only correction for the frequency characteristics of the electrical circuits and equipment, but complete specification of the characteristics of the optical system. The first and obvious item is the width of the scanning or slit image on the film. That is very readily defined.

The next question would be the percentage of light falling within the nominal image width; and even the distribution of light in both directions might have to be specified, especially if we are much concerned with the very high frequencies. The correction of the solid angle of collected light on the photo-cell side would probably have to be specified in order to obtain the same ratio of scattered light to specularly transmitted light in all calibrations.

MR. DAVEE: Those points have already been discussed by the Sound Committee, and as soon as we have the circuits, I believe they will be covered.

Warning!

INTERNATIONAL PROJECTIONIST has no subscription agents and participates in no group offers of either books or other magazines. The only bona fide subscriptions are those submitted directly to the publisher.

Through the courtesy of Mr. F. H. Richardson we learned of an agent who is working through California and other Western states with "combination offers" of I. P. and other magazines, or of I. P. and Richardson's Bluebook of Projection, 6th edition, "at a special bargain offer."

This and any other combination offer of whatever character is a fake, pure and simple. I. P. has no subscription agents and anybody so representing himself is a fraud.

PROJECTIONS

By **Frank Dudiak**

WHAT is the normal fader setting? is a question which brings out not a few diversified opinions. A number of projectionists hold to the view that the lower half of the scale is the most suitable position, provided sufficient amplification is available. Others insist that a few points above the scale center is the most satisfactory position.

The former group assert that the primary advantage of a lower setting is one of quick change-over; with the latter group saying that on a higher setting the possibility of overshooting is considerably lessened. Personally, we favor the latter group, and on a scale of 15 we choose 9 as a "normal" fader setting.

Ionization of a gas is the process of separating electrons from neutral atoms, leaving the latter positive. Consequently, such a gas contains free negative particles and free positive particles.

Now, if a negative and a positive electrode be placed in this gas, a stream of electrons will flow toward the positive, and the positively-charged atoms will flow toward the negative electrode. Like charges repel; unlike charges attract.

This stream of ions constitute an electric current, although the potential in the electrodes must be very high in order to obtain this ionic effect. This, briefly, is the fundamental principle of the photoelectric cell.

Have you ever stopped to consider that in running a two-hour show, 10,800 feet of film pass through the projectors, and in the process 259,200 individual pictures (frames) are projected upon the screen?

On numerous occasions we receive prints that are in excellent physical condition—except for one thing: it is well covered with a mixture of oil and dirt. Also, we frequently find not a few hairs distributed over the film, held there by oil and by the attraction of static electrical charges.

These hairs have a tendency, as the film passes through the projector, to lodge in the picture or sound aperture resulting in their being shown on the screen or, if not this, in sound distortion. This can occasion much grief for the old "dome"—and it won't be dandruff, either.

Just to refresh your memory you might ponder on the four accepted laws of resistance, which we pass along to you herewith:

1. The resistance of a conductor is directly proportional to its length.
2. The resistance of a conductor depends upon the material from which it is made.
3. The resistance of a conductor is inversely proportional to the area in square mils.
4. The resistance depends upon the temperature of the conductor.

That black or clear horizontal line on the outer edge of the film, a comparatively recent development, can easily be utilized to determine the frame line in dark film, irrespective of whether it happens to coincide with the frame line. In the event that it does not coincide, it is only necessary to determine in a scene where visible the number of sprocket perforations between the frame line and the margin line; and of course, the frame line in the dark film is identically located with respect to the margin line.

KEWLEY'S NEW G. E. POST

J. E. Kewley, hitherto General Manager of the Incandescent Lamp Department of General Electric Company at Nela Park, Cleveland, has been elected Vice-President in charge of that division. He succeeds T. W. Frech, a pioneer in the lamp and lighting industry who since 1901 has been intimately associated with the development of the tungsten lamp.

Graphite Anode Aids Tube Performance

WITH the extension of the graphite anode feature, already proved in radio transmitting service, to sound equipment tubes, new standards of performance and life are anticipated, according to a statement by the Hygrade Sylvania Corp. in answer to a question as to the improvement effected by the graphite anode in tubes.

"In the Sylvania 205D, for example," states the Sylvania engineering department, "there is a rugged graphite anode which makes for a sturdier tube, freer from gas and capable of dissipating more power than has heretofore been obtainable from this type. Because of the greater dissipating power, the grid inside the anode is operated at cooler temperatures, thus reducing the possibility of gas and consequent tone distortion from this element. Also, with the new construction longer insulation paths are provided, reducing the possibility of leakage between elements and consequent noises.

"In this tube cobalt nickel alloy is employed for the filament, providing greater emission area and greater tensile strength when hot. The filament will not sag when the tube is mounted in a horizontal position.

"The 242A tube has a thoriated tungsten filament, having been brought out to replace the old oxide-coated 211E which gave so much trouble from gas and short life. A graphite anode is incorporated, with increased heat dissipation readily noted in this type. In sound equipments where molybdenum plate tubes run with anode red hot, the graphite anode Sylvania 242A can be substituted, and while dissipating the same power, the anode will show no color whatsoever. This makes for long life and freedom from output distortion."

STEP-BY-STEP-ANALYSIS OF COMMON AMPLIFIER TYPES

Aaron Nadell

II. The Western Electric 42-A

LAST month a common and familiar type of theatre amplifier was subjected to detailed circuit analysis. The amplifier shown in Figure 1 of the present article is a companion piece to the one described last month. Neither is used without the other.

The reader will note along the right-hand edge of the present drawing a row of terminals for external connections. The fifth and sixth from the top are marked +390 V. Here is the source of the 390-volt plate power used in the amplifier described last month.

To analyze Figure 1 systematically let us first identify the tubes. Along the top of the drawing, near the center, we see a little zig-zag line representing a grid, to the right of it a small rectangle symbolizing the plate, and between the two the inverted "V" that stands for a filament. This arrangement is marked 205-D, V-2, or vacuum tube 2 of this amplifier. Directly below we see the same arrangement of symbols, drawn upside down for the convenience of the draftsman, and marked V-1, 205-D.

Below and somewhat to the right of this pair of tubes are two others, both drawn right side up, marked V-3 and V-4. These also are 205-D tubes. There are no other tubes shown in this drawing.

We can see at once that V-3 and V-4 are not used as amplifying tubes, because the drawing shows that their grids and plates are joined, therefore, these two tubes must be used as rectifiers to provide plate power for the amplifying tubes, V-1 and V-2. Rectifiers mean an alternating current power supply. As in the case of last month's amplifier, it will be advisable, once the tubes have been identified, to trace the power circuits first and the speech circuits afterward.

At the extreme bottom of the drawing there are two terminals, about an inch apart, marked 110V. A.C. The power line is connected to these. Directly above the right-hand power terminal is the door switch, D-1. This is a spring switch, closed by the back cover of the amplifier. When this cover is opened the switch is released and breaks the power circuit as a matter of safety. However, this spring switch cannot provide complete protection, because a powerful charge is stored in the filter condensers, described hereafter.

Anyone working at this amplifier must discharge the filter condensers immediately after opening the back cover, in order to be safe against shock.

Above and to the left of the door switch is the rotary control switch. This has two segments and six contact points. It has three positions. One (not in this drawing, but on the switch itself) is marked "OFF". The second position is marked "FIL.", and the third "PLATE". As drawn in Figure 1, the switch is in the third position.

When the switch is in the OFF position, contact terminals A and D, connecting to the power supply, are open, and no power reaches any part of the amplifier. In FIL position contacts A and D are connected with B and E, which are wired, as the drawing shows, to the lower or primary winding of the 303-C transformer, T-3.

Let us assume that the switch is set at FIL. and trace the power circuits active at that setting.

The 110-volt A.C. flowing through the primary of T-3 induces a 4.5 volt alternating current in each of the two secondary windings of that transformer. The secondaries are seen just above the grounded transformer core, which in turn is drawn just above the primary. Each of these secondary windings has a center tap which does not concern us just now. From the outside terminals of the left-hand secondary a pair of 4.5 volt lines run upward to the parallel filaments of V-1 and V-2. The parallel filaments of V-3 and V-4 are supplied by the right-hand winding of this transformer.

Transformer T-3, therefore, is the filament power transformer of this amplifier, having two secondaries, each of which lights the filaments of two tubes. These tubes are lighted the moment the rotary control switch is set at FIL. position, in which it supplies current to the T-3 primary.

After the filaments of these tubes have been heated for a short while the rotary control, or "FIL.-PLATE SWITCH" is thrown to the PLATE position, as shown in the drawing. In this position terminals C and F are connected in parallel to the 110-volt line, and the line power is also supplied to the primary winding of the right-hand transformer, 303-B, T-4.

The secondary winding of this transformer—only one winding, in this case, equipped with a center tap—has more turns than the primary, and delivers a higher voltage than 110; probably in the vicinity of 600 volts. The left-hand terminal of this secondary connects to the plate of V-3; the right-hand terminal to the plate of V-4.

With respect to these two tubes, the grids may be thought of as merely physical extensions of the plates, since grids and plates are wired together.

Since the current developed in the secondary of T-4 is alternating, the polarity of that winding will reverse its direction periodically. The two outside terminals will be positive and negative alternately. Therefore, the plate of V-3 will be positive while the plate of V-4 is negative, and *vice-versa*.

Current flows across the vacuum of a tube only when the plate of that tube is positive and at no other time. Therefore, these tubes do not both operate at the same time but alternately.

This high voltage circuit we are tracing, which originated in the secondary of T-4 transformer, runs through the vacuum of either V-3 or V-4, thence from the filament of either tube, through the right-hand secondary of transformer T-3, and out and upward from the center tap of that secondary.

In the wire leading upward from the center tap of the right-hand secondary of T-3 the high-voltage current is direct current, flowing always in the same direction, regardless of whether it comes from V-3 or from V-4. Those two tubes have to perform the function of rectifiers, converting the A.C. created in the secondary of T-4 into D.C.

The circuit of V-3 and V-4 is that of a "full-wave" rectifier, because it operates upon both halves of the alternating cycle. Remove either tube from its socket and the circuit would be that of a half-wave rectifier. In the wire leading upward from the center tap of the right-hand secondary of T-3 the current would be D.C., but flowing only half the time.

The direct current drawn from this

full-wave rectifier is not smooth and constant. This is easily understood. Consider a moment when the alternating current supplied to this rectifier is changing its direction of flow. At that moment the plates of both V-3 and V-4 are at zero potential, they have no charge at all, and no current flows across the vacuum of either tube.

Therefore, the direct current drawn from this rectifier is pulsating, varying periodically between zero and maximum. Those pulsations must be removed and the current "smoothed out" before it can be used in the amplifying tubes V-1 and V-2.

Beginning at the center tap of the right-hand secondary of T-3, the positive line of this high voltage circuit—now converted to a D.C. circuit—runs upward, right and then upward to the lower end of the 134-A retard coil, L-2, which is part of the filter system by means of which the pulsations or irregularities are removed from the direct current of this circuit.

From the upper end of L-2 upward, left and again upward to retard coil L-1. Thence upward to the milliammeter, M-1, which records the amperage flowing. Thence right to the center tap of the output transformer, T-2. Here the circuit branches into two parallel lines, one of which flows through each half of the transformer and from there to the plates of V-1 and V-2.

From the filaments of those tubes the circuit continues downward through the two wires leading to the left-hand secondary of T-3. From the center tap of this secondary upward and left. Two wires lead upward. One runs to the .5 microfarad by-pass condenser C-9.

Since only A.C. can pass through a condenser, the d.c. circuit we are tracing cannot run that way. Therefore, it has no other path except upward through the 575-ohm resistor, R-2. From the upper end of this resistor it runs upward about an inch, right about three inches, and downward about two inches to the center point of the secondary winding of T-4, which constitutes the negative terminal of this circuit.

What we have been tracing is the plate power supply for the two tubes, V-1 and V-2. It begins as alternating current in the secondary winding of T-4. Only one-half of this winding operates during any given moment—the positive half. Therefore, the negative source of this circuit is always the center point of the secondary winding of T-4, and its positive source is whichever of the two outside terminals of that winding happens to be positive at the moment.

The arrangement of the two tubes, V-3 and V-4, constitutes a full-wave rectifier, converting this high-voltage a.c. to high voltage d.c. Leaving the rectifier system, the circuit continues to a filter, composed of the coil L-2 and two banks of filter condensers—C-1, C-2, C-3, C-4, and C-5, C-6, C-7, C-8. The coil L-2 is in series with the line and the two banks of condensers bridge across from the positive to the negative side of the line. This arrangement constitutes a "brute force" filter for smoothing the irregularities of direct current drawn from a rectifier.

These are the two banks of condensers that hold the dangerous charge previously spoken of in connection with the door switch, D-1. Look at the points where these condensers connect to the negative line. Halfway between those two points a wire will be seen running to the right to a terminal marked "GND.-PLATE." The negative side of this high voltage line is grounded. Whoever attempts to work on this amplifier should discharge the filter condensers as soon as he opens the back cover, by grounding both terminals of the coil L-2. This can be done with a screw driver that has a well-insulated handle.

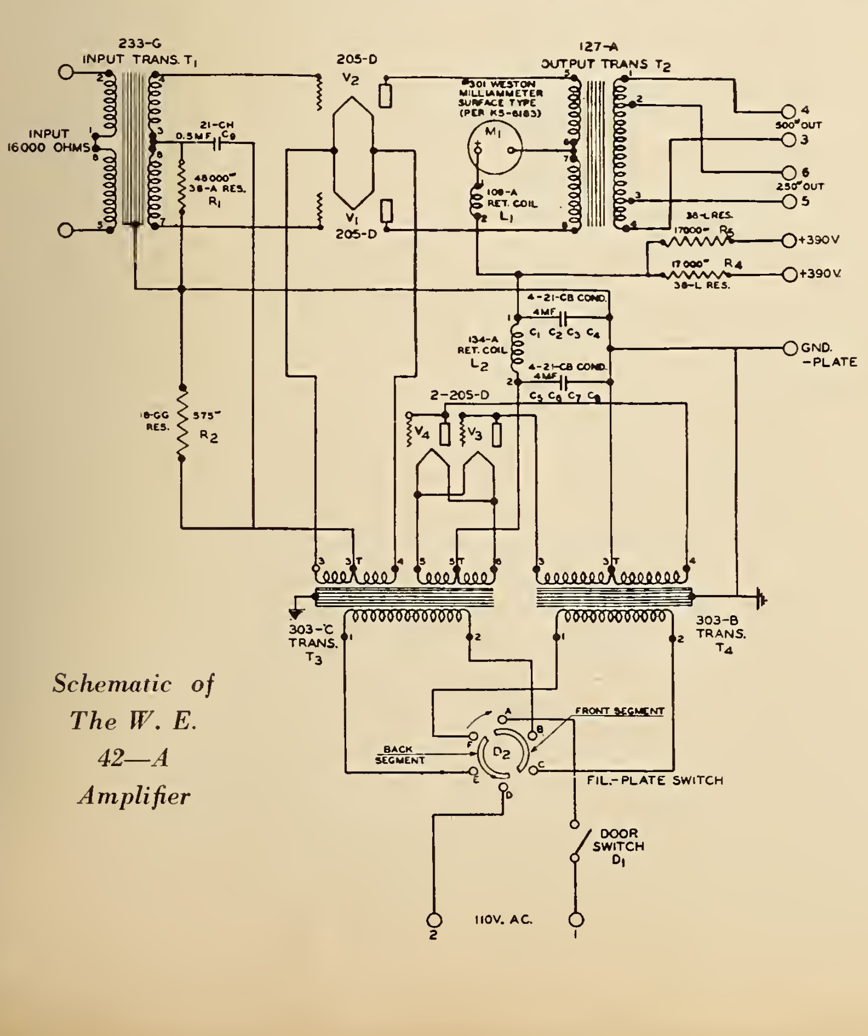
About a half inch above the upper terminal of the filter choke coil, L-2, a branch circuit runs off to the right, and then branches again, running through two 17.000-ohm resistors to two terminals marked +390V. Thus the plate rectifier and plate filter of this amplifier can be used to provide plate power for two amplifiers of the type examined last month. Commonly, however, only one of them is used with the amplifier shown here.

We have now traced the filament and plate power circuits; the grid bias and speech circuits remain to be considered.

Grid bias is obtained by means of the voltage drop through the 575-ohm resistor, R-2. The plate current flowing through this resistor is approximately 60/1.000ths of an ampere, or 60 mils., and this current, multiplied by 575 ohms, gives a voltage drop across R-2 of 34½ volts.

The lower, or positive end of R-2 connects with the filaments of V-1 and V-2 through the left-hand secondary of transformer T-3. The upper or negative end of R-2 connects with the grids of V-1 and V-2 through the grid resistor R-1 and the secondary windings of transformer T-1. Since the grid bias is voltage only, and not current, there is no drop in resistor R-1.

There is very little drop in the windings of the left-hand secondary of T-3, which are heavy enough to carry the 3.2 amperes needed for lighting the amplifier tubes; hence the grid bias of this amplifier is substantially the same as the drop across R-2, or 34½ volts, more or less, depending upon the plate current flowing, which in turn depends upon the 110-volt line voltagc



Schematic of The W. E. 42—A Amplifier

and the condition of both sets of tubes.

The speech circuit enters this amplifier at the terminals of the left-hand, or primary, winding of the 233-G input transformer, T-1. Those two terminals connect to terminals 1 and 2 in the upper right-hand corner of last month's drawing, and together with the primary winding of the input transformer T-1 represent the speech input circuit of this amplifier.

The grid speech circuit originates in the secondary winding of transformer T-1. It has two branches, one to the grid of each amplifying tube. The return to the filaments of the amplifying tubes runs through the .5 mf. condenser, C-9, which short-circuits the grid a.c. component around resistors R-1 and R-2.

The plate speech circuit has two parallel sources, since it originates between the plate and the filament of each amplifying tube. These two circuits run together at the mid point of the primary winding of the output transformer, T-2. Thence the return to filament runs through the milliammeter and the coil L-1, and is by-passed around the filter and rectifier through the condensers C-1, C-2, C-3 and C-4. The latter thus serve as by-pass condensers for the plate alternating component as well as filter condensers for the plate d.c. power.

The last speech circuit originates in the secondary of the output transformer, T-2, and may be connected to run through either the 500-ohm terminals of that winding, 1 and 4, or through the 250-ohm terminals, 2 and 3. Thus, this amplifier may supply speech power (2.4 watts) to a loud speaker matching transformer of 500 ohms input, to an additional amplifier of 500 ohms input, or to two additional amplifiers connected in parallel, with a joint input impedance of 250 ohms.

The amplifying circuit represented by V-1 and V-2 is called a "push-pull" circuit. Alternating speech current is induced in the secondary winding of input transformer T-1. Hence each terminal (4 and 7) of this secondary is alternately positive and negative with respect to its mid-point. Therefore, the grid of the V-1 "swings" positive with respect to its bias, while the grid of V-2 swings negative, and *vice versa*. The space current flowing through the vacuum of V-1 must increase while the space current through V-2 declines; until a moment later the V-2 space current rises and that through V-1 drops off.

This see-saw, "push-pull" arrangement gives greater undistorted speech power than could be obtained by using the same two tubes in a simple parallel arrangement, since certain important forms of distortion introduced by the tube are cancelled out by the push-pull operation. Nearly all theatre amplifiers use push-pull circuits in their later, or power, stages. Some use it throughout.

The amplifier shown here is the Western Electric 42. That given in last month's article was the W. E. 41-. The 41- and 42-, together, provide enough amplification for a small- to medium-size theatre. When more power is needed, one or two 43-type amplifiers are added between the 42- and the speaker matching transformer.

The 43-amplifier is extremely similar in circuit to the 42, so much so that even the drawings of the two look very much alike. Anyone who has followed the analysis of the 42-, just given, should have no difficulty in understanding the circuits of the larger amplifier.

The 43- uses either 211 or 242 tubes, in place of 205's. It does not have a branch power circuit to correspond with the two +390V. terminals at the right-hand side of this amplifier, because it does not supply plate power to anything but its own amplifying tubes.

The 43- tubes have 10-volt filaments using about 3 amperes. The amplifier tube plate voltage is 750, and the plate current about 125 milliamperes. The grid bias is obtained in the same way as in the 42-, only instead of the 575-ohm resistor, R-2, the 43- uses two resistors totaling 312 ohms, resulting in a grid bias of between 37 and 40 ohms, depending upon the 110-volt line voltage and the condition of the tubes. Both of these factors vary the amount of space current flowing and therefore the drop through the 312-volt resistor.

There are also certain minor differences between the two circuits. The 43- uses matching resistors in parallel to both the primary and the secondary of the input speech transformer. The back cover safety switch on the 43- breaks both sides of the a.c. line, and there is also a front cover safety switch because the filter condensers of the 43- are mounted in front of the panel and protected by a separate cover. They carry a much heavier charge than the condensers of the 42-, and it is very important to discharge both banks before touching any of the connections of the amplifier.

The familiar Western Electric 46-type amplifier takes the place of the 41- and 42-, and is very nearly a combination of those two amplifiers in one unit. Nearly all W. E. amplifier assemblies consist either of a 41- and 42-, or of a 46-, or of a 41- and 42- together with one or two 43's, or of a 46- with one or two 43's.

The present article, taken together with that which appeared a month ago, should provide a helpful guide to the internal circuits of any or all of those amplifier combinations.

What's New?

DESCRIBED as an entirely new development in motor generators for projection work, the new Stabilarc Unitwin has been placed on the market by Automatic Devices Co., of Allentown, Penna. Developed especially for use with the new 50-ampere, 35-volt D. C. lamps now being marketed by various manufacturers, the Unitwin consists of a 5 h.p. A. C. motor and two specially designed 50-ampere, 35-volt D. C. generators—one for each lamp and mounted on each end of the generator.

No ballast resistances are required. Each generator feeds directly into its own lamp without power loss, thus eliminating any possibility of variation in screen illumination during change-over.

By this method of conversion from A. C. to D. C., points out the company, real, true D. C. is supplied to lamps without pulsations or flicker, regardless of any voltage variation in the A. C. supply. No replacement parts are required. The Unitwin is said to be as economical as any known method of conversion.

The rotating element is mounted on oversized ball-bearings and is dynamically balanced at full speed, thus assuring quiet and vibrationless operation. Complete data is available from the manufacturer.

NEW BALDOR RECTIFIER

Now ready for general distribution is the new Handy Motion Picture Rectifier, manufactured by the Baldor Electric Co., St. Louis, Mo. At present this rectifier is made only in one size to produce 30 amperes at 55 volts.

The features of this rectifier, according to the Baldor Co., are an adjustable arc current, constant arc voltage, economical operation and compactness, the rectifier requiring less than one square foot of floor space.

M. L. Robinson Associated

Associated in the building and marketing of this rectifier is Mr. M. L. Robinson, known to many projectionists and all supply dealers through his work with the Roth Actodector. Inquiries regarding this new rectifier can be sent either to Mr. Robinson at 5016 No. Paulina St., Chicago, or direct to the Baldor Co. in St. Louis.

BILLY GLUCK ASSIGNED

Mr. William (Billy) Gluck has been named sales manager of Amusement Supply Co., theatre supply dealers in New York. Gluck is well known to projectionists throughout the country, particularly in the East.

Charney is Agfa Distributor

C. King Charney has been named distributor of Agfa 35 mm. negative and positive film for the United States, according to an announcement by the Agfa Ansco Corp. Mr. Charney, long identified with the film industry, will maintain offices and warehouses in New York and in Hollywood.

The IP EDITORIAL PAGE

Vol. 7, No. 1 JULY 1934

The S. R. P. and Film Mutilation

Revisions of the Standard Release Print having been ushered in with the inevitable columns of type, we may now proceed to forget all about the matter—to continue to hack and mark and cut prints just as we always did. Sarcastic? Not a bit. It is perfectly all right with us to add another six frames to the picture runout following the change-over cue, but it means little or nothing. Any projectionist who finds eighteen frames following the cue insufficient for his needs will likewise have the same difficulty with 24 frames. The savings in film stock thus effected in this latest revision of S. R. P. could easily be doubled without inviting projection troubles.

Still to be settled is the question of reel length. First suggested by the Academy was the 1,700-foot length. We gather from personal contact with exchange men and producers that they are quite satisfied with 1,000 foot lengths. Some projectionists favor a maximum length of 2,000 feet and a minimum length of 1,700 feet. If doubling is to be eliminated, either one of two things is necessary:

1. The larger reel, with 2,000-foot as the maximum and 1,700 feet as the minimum, will have to be adopted; or
2. Some penalty will have to be imposed for film damage, payable by the theatre to the exchange, with the former in turn collecting from the projectionist.

Until such time as some means is devised for imposing a penalty for film mutilation, the problem will remain unsolved. Projectionist groups, research councils, societies, academies, or what have you, will not answer this question by the mere issuance of reports, surveys or the like.

New Type Arcs. What of the A. C. Lamp?

Ever since the time some three months ago that Mr. Lester Bowen contributed his views on the relative merits of the new D. C. and new A. C. arc lamps, we have been hoping against hope that some equally proficient stalwart of the A. C. lamp would rise to the occasion and with both force and weight of argument fling Mr. Bowen's contentions into the dust. Not that we are anxious to have the latter's ideas overthrown do we voice this hope, but rather because we know of nothing so efficacious as controversy and plain speaking to rip the lid from such problems.

To date all the honors lie with the D. C. camp. To the credit of the A. C. contingent, however, it must be said that they have never claimed perfection for their product. They admit that the A. C. lamp is just that and no more, that it acts in the well-defined manner of all A. C. arcs, that it never was intended for the larger theatres and for the extreme uses to which it is now being put (to its general discredit), and that it did offer a vastly improved light to those theatres heretofore limited in terms of quantity and quality of light by the low-intensity lamp.

Much more outspoken are the D. C. cohorts, who assert that the new 50-ampere D. C. lamps not only surpass the present-type hi-lows but actually match existing high-intensity lamps. Certain figures culled from a series of actual tests would seem to bear out this claim. There can be no question that the aggressive tactics of the D. C. crowd have gained popular approval, irrespective of the actual worth of their fancy—and at the expense of the A. C. lamp.

Personally, it seems to us that for those who insist upon being sticklers for that which is correct and proper down to the last fine hair, the D. C. lamp will prove to be the answer. However, there is a vast field to be exploited by the A. C. lamp manufacturers, comprising those houses which up to now have used only low-intensity arcs and are ready and willing to obtain a vast improvement in quantity and quality of screen illumination at the cost of less steadiness in light. That the A. C. arc, in the very nature of things electrical, is less steady than is the D. C. arc there can be no question.

We have no patience, however, for those who assert that if the pulsating character of the A. C. arc is not visible to the average human eye, it simply doesn't exist. A. C. fluctuations do exist, and they cannot be explained away in any such nonsensical fashion. Those who take their projection seriously should always aim at perfection, or as near perfection as it is possible to hit. In tolerating even a slight departure from that which we know to be correct we are inviting attention to the tendency of the theatre business to put over anything, provided it can get away with it.

Unfortunately, this matter of arc types at present is really more of an economical problem than a technical one; and we are prepared to vote for the A. C. arc in preference to the low-intensity types which now make of motion pictures in thousands of theatres more of a trial than a pleasure.

Ultimately, we think, the answer will be D. C., but it may well be that the A. C. arc will help mightily in blazing the trail toward better screen illumination.

In a recent issue of *Motion Picture Daily* there appeared the following interesting commentary on the projection process as sometimes practiced:

> **_Showmanship in the Booth_**
>
> San Francisco, May 13.—Here's one that may become a local classic:
>
> Toward the tail end of a feature running beyond the usual closing time, a careless operator in an outlying but crowded theatre discovered that he had misplaced the sixth and last reel. Frantically he looked for the last reel as the fifth neared its end. The picture at this stage was crammed with suspense. In almost the last second his bungling fingers picked up an old dust-covered slide used in the primitive days for just such emergencies. Desperately he flashed it on the screen. The slide, depicting a beautiful, romantic moonlight scene, read:
>
> "And So This Story Ends . . . . And We Bid You All Good Night."
>
> The projectionist is still looking for a job and the audience suspense continues unsatisfied.

Ruffled? Not a bit. As a matter of fact we are tremendously cheered by the appearance of this item, because after listening to exhibitor arguments at the code hearings, before N. R. A. boards, before legislative bodies and elsewhere, we were well on the road to believing that projection was a purely mechanical process, requiring only the press of a button from the manager's couch at the beginning and ending of the day's run.

NEW 0.945 SPROCKET CUTS FILM MUTILATION

James J. Finn

THEORETICALLY there is no connection between the super-sensitive ears of some motion picture projectionists and the introduction by International Projector Corp. of a new 35 mm. feed sprocket having a diameter of 0.945 inch. But, practically there is a direct connection—and therein lies a tale.

The reasons back of the introduction of this new sprocket are of particular interest to the projectionist, the producer, the film manufacturer and the projector manufacturer. The base of this whole sprocket problem is none other than our old acquaintance and consistent trouble-maker—film mutilation.

For years now the standard sprocket has had a diameter of 0.935 inch. The reason for such a diameter is not quite clear—it just is, that's all. Of late, however, the consistent trickle of complaints anent film mutilation has steadily been enlarged into a raging torrent, fed by innumerable protests from theatres throughout the world. Obviously, something had to be done about the matter. But what?

Widespread Film Mutilation

First in line to receive the full impact of these complaints was the Eastman Kodak Company, which for many years has borne the brunt of this critical deluge. The Eastman technical force experimented lavishly, neglecting no possible fault-producer. Out of the welter of such intensive and prolonged work finally came the answer to the problem —a clear-cut declaration of the guilt of the sprocket, which was destroying hundreds of thousands of dollars worth of film stock yearly as it whirred unceasingly in picture theatres throughout the world.

Eastman Kodak then turned to the International Projector Corp. Couldn't something be done about this matter of sprockets? Yes, answered International, something could be done, but time was necessary in which to conduct certain tests and carefully check the whole problem in terms of ten-thousandths of an inch, or even less. That something *was* done, and the result is now in hand in a new standard feed sprocket.

Into the Fall (1933) meeting of the S. M. P. E., held in Chicago, walked Mr. Herbert Griffin, technical pontiff of International Projector Corp., who proceeded to set the air in motion by voicing the results of an exhaustive investigation conducted by his company into this whole matter of sprockets. "Exhaustive" is certainly the word, for Mr. Griffin's paper[1] ran to some 30 pages and contained 19 illustrations.

Briefly summarized, Mr. Griffin said that it was time for a new deal in sprocket dimensions—and he proceeded to tell why. Months of work, scores of drawings and the records of extensive and exhaustive tests buttressed the Griffin statement, which figuratively mopped up the sprocket situation, particularly as it affects film mutilation, until the topic was as dry as a sunbaked bone.

The New 0.945 Sprocket

The net result of all this activity is a new sprocket of 0.945 inch diameter. Had Mr. Griffin taken into consideration the very important matter of film shrinkage, which vitally affect sprocket dimensions? He had; and to prove it he submitted a chart (Figure 1) which dealt conclusively with this angle.

Were there any more questions? There were; and all were satisfactorily answered. It was shown, for example, that the 0.945 sprocket matched precisely the pitch of a film that had shrunk 0.15% and therefore had clearance all the way down the line. Theoretically, at this point all the sprocket teeth are in engagement, which constitutes an ideal condition. With the 0.945 sprocket the tooth that does all the work is the last tooth in contact with the film before it enters the lower loop—in other words, the outgoing tooth. This really is an ideal condition, because it constitutes a direct "pulling" action on the film.

With the 0.935 sprocket, however, it is interesting to note that practically all the work is done by the incoming sprocket tooth (at the intermittent sprocket tension shoe), which gives poor results because it constitutes a very positive "pushing" action and causes "cramming" of the film. This snubbing action becomes more pronounced as the sprocket diameter is decreased within the range from 0.945 down to 0.935.

Would the 0.945 sprocket help to effect a sharp decline in film mutilation? It certainly would and does, as has been conclusively established by an exhaustive series of test runs with long, short and medium-size lengths of film. Added up, the net result of these tests was that the 0.945 sprocket extended the average life of film *at least six times* beyond that possible through use of the 0.935 sprocket. Eliminated was that pushing, cramming and ripping action of the latter sprocket. Then, everything is fine, is it not? The answer is, "No, it isn't fine"; and the reason why it isn't fine is Mr. Projectionist of the group recently cited as the possessors of super-sensitive ears.

What is this heresy? What is the

Fig. 1. Chart showing interference and slippage in relation to base diameter of feed sprocket, and shrinkage of film. Figures above heavy line indicate interference in inches between edge of perforation and entering tooth. Figures below heavy line indicate slippage in inches from leaving to entering tooth

PER CENT SHRINKAGE	SPROCKET DIA. IN INCHES.					
	.945	.944	.943	.942	.941	.940
0.0	.00028	.00047	.00066	.00086	.00106	.00126
0.13	.00004	.00023	.00042	.00062	.00082	.00102
0.15	.00000	.00019	.00038	.00058	.00078	.00098
0.2	.00009	.00010	.00029	.00049	.00069	.00089
0.3	.00028	.00009	.00010	.00030	.00050	.00070
0.4	.00047	.00028	.00009	.00011	.00031	.00051
0.5	.00065	.00048	.00029	.00007	.00013	.00033
0.6	.00084	.00065	.00046	.00026	.00006	.00014
0.675	.00098	.00079	.00060	.00040	.00020	.00000
1.5	.00252	.00233	.00214	.00194	.00174	.00154

[1] Sprocket Dimensions, J. Soc. Mot. Pict. Eng., XXLI (January, 1934), No. 1, p. 20.

objection to this new 0.945 sprocket, the finest job of its kind ever turned out, of a type that not only gives perfect service but actually reduces film mutilation in projection by at least five-sixths?

The Sensitive Souls

The answer to these questions lies in the experience of International Projector Corp. during the job of replacing the old sprocket by the new. It is nothing more or less than super-sensitive ears—projectionists' ears which, assailed by almost every conceivable kind of raucous noise in the projection room, surprisingly retain the ability of detecting the slight extra flapping sound between sprocket and film which is induced by the new 0.945 sprocket.

It is freely admitted by all concerned that this new sprocket does give rise to a bit more noise than did the old 0.935 type. And, sad to relate, there is absolutely nothing that can be done in the way of supressing the noise. However, during a special demonstration arranged for this writer at the International factory, the extra bit of flapping noise resulting from the use of the new 0.945 sprocket did not shape up as a major worry for the projectionist. The noise is more "worrisome" than actual, and is this only because it is *different* from the sprocket noise heretofore experienced.

Certainly this new 0.945 sprocket induces a noise differing from that produced by the old type sprocket, but it can be stated definitely that the difference is wholly one of *character* rather than of degree, is of such a level as to be infinitesimal and to require extremely close attention for its detection, and after a few days run should be lost in the myriad noises present in the projection room.

Thus, by a somewhat devious route we come to the crux of this article, which is the bald statement that projectionists should concentrate on the manifold advantages of the new 0.945 sprocket and not be finicky or mulish about its "noise," admittedly different from that of other type sprocket, but which is nothing at all to worry about.

Of interest to those projectionists whom Nature has endowed with such delicately attuned ears is the information that International Projector Corp., secure in the knowledge that the new 0.945 sprocket is correct in every essential and constitutes a major contribution to the projection art, will proceed with the work of replacing the old-style sprockets with the new.

In the opinion of this writer, the new 0.945 sprocket is not only right in every particular but represents a great advance in projection work. Those projectionists who persist in favoring their overly-sensitive auditory organs by carping about imaginary harmful noises are merely holding up the parade of progress. Cease and desist is the advice in order.

Answers To Questions

(Questions on Page 7)

1. The two parts of a logarithm are the *mantissa* and the *characteristic*. The characteristic is that part to the left of the decimal point and is based upon the number of whole numbers in the figure under consideration. The mantissa is that part of the logarithm to the right of the decimal point and is based entirely upon the combination of numbers making up the figure under consideration.

2. To raise any number to a power by the method of logarithms, multiply the logarithm of the number by the power, the product being the anti-log of the desired answer.

3. The fact that the slide rule is based upon logarithmic principles.

4. (a) $5+7+24+36-8+2=?$

$74-8=66$, *Answer.*

(b) $61-25+56=?$

$117-25=92$, *Answer.*

(c) $8-5 \times 3+(6+4+1)=?$

$8-15+11=?$

$19-15=4$, *Answer.*

(d) $\sqrt{(4+5 \times 2)}+11=?$

$\sqrt{(4+10)}+11=?$

$\sqrt{14}+11=?$

$\sqrt{25}=5$, *Answer.*

5. $27y-7b+3$

$21y+18b-17$

Changing signs of the subtrahend and adding,

$27y-7b+3$

$-21y-18b+17$

$6y-25b+20$, *Answer.*

6. Multiplying,

$-7 \times 6=-42$

$-4 \times -5=20$

$8 \times 9=72$

7. Dividing,

81 by $9=9$

56 by $-8=-7$

-44 by $-8=5\frac{1}{2}$

8. $-5^3=-125$

$4^2=16$

$-2^5=-32$

$-2^4=16$

$\sqrt{16}=4$

Novel Fair Exhibit on Science of Seeing

Electricity's assistance in promoting the science of seeing is vividly shown in the 1934 Science of Seeing exhibit at Chicago's World's Fair. Entirely new sound movie equipment both demonstrates and explains the use of light.

The first demonstration is "Glare", in which by a novel arrangement are shown the effects of bright or dim light thrown upon the object looked at. Another demonstration is called "Contrast", in which objects are seen against varying backgrounds, and one may note the effects of change in the amount of light used.

In a test of "Speed of Vision", the letters of the alphabet appear upon a revolving cylinder. This cylinder appears to revolve very rapidly under dim light so that the letters blur and become invisible, and under bright lighting the revolutions appear to become slower and the letters are easily read, the fact being that the cylinder revolves at fixed speed and that the device shows the increase in speed of vision under adequate light.

Small-Town Character of Movie Business Shown

PROOF that the motion picture industry is essentially a "small town" business was adduced in a recent survey which shows that out of a total of 16,849 theatres now operating throughout the United States, more than 10,000 have 500 seats or less. Further, some 11,000 of these theatres are located in towns having less than 20,000 population.

Very Few De-Luxers

There are only 110 theatres in the U. S. with 3,000 or more seats, which is even more than was generally thought. So much for these "big motion picture palaces" about which so much is written but which small-towners never see.

Boiled down, the big punch of the summary is that more than 8,000 U. S. theatres seat less than 500, with five-sixths of all theatres being under the 1,000-seat mark. Complete figures follow:

Population	Cities	Theatres
Over 500,000	13	2,215
200,000 to 500,000	27	1,025
100,000 to 200,000	53	778
50,000 to 100,000	95	775
20,000 to 50,000	258	1,168
7,500 to 20,000	726	1,703
4,000 to 7,500	867	1,400
2,000 to 4,000	1,464	1,806
1,000 to 2,000	2,023	2,149
1,000 and less	3,734	3,830
TOTAL	9,260	16,849

Seats	Theatres
3,000 and over	110
2,000—3,000	346
1,500—2,000	621
1,000—1,500	1,327
500—1,000	4,280
200— 500	8,190
200 and under	1,975
TOTAL	16,849

Mechanism of Seeing Is Discussed by Luckiesh

WHILE brightness influences the certainty of seeing, it must be increased tenfold to increase certainty of seeing from threshold to 100 per cent certainty, says Dr. Matthew Luckiesh in his new 200-page book, *Seeing and Human Welfare* (Williams & Wilkins Co., Baltimore, $2.50). Dr. Luckiesh is director of the General Electric Lighting Research Lab. at Nela Park, Cleveland.

'Seeing Time'

Concerning the importance of the time factor in seeing Dr. Luckiesh says: "Everyone must be conscious of the fact that it takes time to see. The rate of growth and decay of sensations can be measured. Likewise, the human seeing-machine requires time to react and reaction-times are involved in seeing. Motion pictures are made possible by the persistence of vision. Also it is generally conceded that we do not see when the eyes are in rapid motion. This is a fortunate development, because it eliminates the blurring of objects as the focus of the eyes moves from one place to another in the visual field.

"If only when the eyes are at rest, the stopping time of the eyes is important. The average stopping-time of the eye is 0.17 second. In extensive tests of this it was found that the briefest interval of time that it is possible for an observer to fixate an object in order to gain an adequate visual impression varies for the most part from 0.07 to 0.30 second. Average is 0.17 second.

Time and Intensity

"The period of time available for seeing has considerable influence upon the threshold values of other factors. A critical detail of a size just visible when it is exposed to view for 0.3 second becomes invisible when the time is decreased. If an object of 50 per cent contrast can just be seen under a certain intensity of illumination when the time available is 0.3 second, the intensity of illumination must be trebled if it is to be visible when the time is reduced to 0.07 second."

NRA Names Committee to Fix N. Y. City Scale

A committee of five has been named by Division Administrator Rosenblatt to set a wage scale for New York City, members of which are: Charles Moscowitz, Loew's; Major Thompson, R-K-O; Harry Brandt, Independent Theatre Owners; Charles O'Reilly, Theatre Owners Chamber of Commerce; Joseph Blatt, Empire Union, and George Browne, I. A. T. S. E. president.

Close observers opine that this committee, constituting a radical departure from the announced intention of the NRA to name an "impartial arbitrator", could have been named seven months ago and saved thousands of dollars in expense and much trouble.

Indecent Pictures, 'Star' Salaries and Industry Finances

THEY talk now in every corner of the motion picture business about the current church crusade against indecent motion picture presentations, about exhorbitant and "wholly unjustified star salaries", and about the industry's "poor financial sense". This writer rises to ask: Since when was all this news?

It really is to laugh to read some of the two- and three-page editorials now being published (now that the horse is stolen, so to speak) in certain industry trade journals. Where were these aspiring Horace Greeleys last year, and the year before, and even before then? Of course, a double-page editorial on the church campaign is what is known as "timely" and "pertinent" at the moment, but the subject matter of all this editorial hash is old, old stuff to anybody who has known this industry for more than two years. These editorial defenders of the faith who now bend to the task of revealing all are made to look foolish by now doing a job which cried out to be done months and months ago.

These "problems" have been apparent for years and were set forth in INTERNATIONAL PROJECTIONIST as long ago as March, 1933. Hark back to an article entitled, "Organized Labor: The Football of the Picture Industry", which appeared as aforesaid. Prophetic indeed was this article, despite the fact that its content fell on barren ground insofar as the alleged mental giants of this business are concerned. Recall these choice excerpts:

" . . . Ever since the organization of the West Coast studios was accomplished with the help of Mr. Sidney Kent, Mr. Hays (Will H., president of the M. P. P. D. A.), hasn't dabbled much in labor matters. The result of the Coast organization probably indicated to Hays that he didn't possess the same master touch for dealing with unions as he did for lining up women's clubs so that the brutally boorish pictures produced by the industry might not be downed in a tidal wave of feminine protest.

"Who remembers the Moral Code promulgated some months ago by Mr. Hays? Very few producers, if one is to judge by the character of pictures being produced these days. They think that high salaries paid to Union workers are ruining this business, but they are all wrong.

'She Done Him Wrong'

"How many pictures are made these days to which a fellow might bring his mother or his best girl and not feel a bit embarrassed by the run of sexy stuff that is on display. What entertainment value is there for anybody under 16 or over 40 in the current crop of motion pictures? The answer is, damned little!

"This writer prefers to judge Mr. Hay's stewardship on the basis of a current motion picture ad which proclaims that ' . . . on her wedding night she left him for another man' or on the terribly harsh sex stuff which embellishes the latest Mae West release. And Mr. Hays worries about Unions and salaries!

"The trouble with the picture business is that in which Mr. Hays has never exhibited any interest. What has Hays done to curb the overseating evil, now some ten years old? In some towns there is a theatre seat for every three inhabitants; and a seat for every ten inhabitants, babies and invalids included, is the general average!

Wild Theatre Building

"What did Mr. Hays do when producers, unable to sell this or that outlet, proceeded to build a fine new theatre, whether needed or not, and put the little fellow right on the skids and thus break the backbone of the industry? What did

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In New York City, Bernard S. Deutsch president of the Board of Aldermen, announced the outlawing of company unions and the mandatory inclusion of collective bargaining provisions in all franchises issued by the city. First application of the ruling will be made in franchises covering 40 bus routes.

Mr. Hays do when this and that State, and this and that municipality, slapped a tax on picture theatres and made it stick?

" . . . Ask any exhibitor of more than five years' experience what the outstanding industry problem is and has been for years and he will positively answer "Overseating." Either that or, "Bad pictures"—another matter about which Mr. Hays has done nothing.

What of the Little Fellow?

"Two other points come to mind: 'star' contracts and real estate deals. As for the latter, every company in the business was put on the bum through having to pay in 1931-32 the rentals on theatres leased in 1928, at 1928 prices, while the owners did nothing but sit on a campstool and wail for the mailman to deliver the check from New York. And this was after the little fellow had been put out of business by the hoggish attitude of the big companies in the matter of new theatre jobs.

"They talk about Union wages the while Hollywood is cluttered up with alleged 'stars' who haven't made a picture in months but still are collecting weekly salaries, all of which is charged against the business. How about Lilian Harvey, petite Fox importee, who has been on salary in Hollywood for a year and never faced a camera? How about Anna Sten, German actress, who has been on the Coast for a year on full pay and has done nothing but take English lessons and make silly tests? Who said 'Unions'?

'Stars' and Relatives

"The cost of these 'stars' will be worked into future pictures and passed along to the exhibitors, who will find that film rentals are so high as to cause a request for reduction in . . . wages or manpower. How about the hundreds of relatives on Hollywood payrolls, for no better reason than that they sprout from the same family tree as the boss back in New York. These relatives are an important part of film rentals, an important part of general industry economics . . ."

All this, mind you, back in 1933—before the NRA, before the outbreak of the church campaign, and before the trip of Mr. Sol A. Rosenblatt to California to "investigate" production conditions. Mr. Rosenblatt need not have stirred out of Washington or New York, because the facts which he now releases as the result of his investigation were matters of common knowledge in every Film Row in the land.

The troubles of the motion picture industry may best be learned not in and from Hollywood, but in and from the average motion picture theatre, the existence of which is hardly suspected by the Hollywood horde.

James J. Finn

RCA Develops Personal Sound Movie Outfit

One of the most interesting papers delivered before the recent meeting of the S. M. P. E. cited the development of a simplified apparatus which promises to make it possible for anyone to make personal sound movies in the near future. Since the advent of sound, RCA Victor Co. engineers have been working on the problem of developing a practicable amateur sound camera which would be compact in size, and simple and economical to operate.

The sound camera discussed utilizes 16mm. film with a narrow track on one side for recording sound. It was described as a "newsreel" type, incorporating the sound recording system in the single light-weight camera case.

As the subject is photographed, the operator talks into a mouthpiece leading to a vibrating metal diaphragm. This diaphragm, which is set in motion by the speaking voice, is coupled mechanically to a tiny mirror which vibrates in unison with it. A light beam directed on the mirror is reflected with its fluctuations on the sensitized edge of the film as it passes through the camera.

For recording the voice of the person or group being photographed, as well as for atmospherical sound effects, a separate microphone attachment together with electrical amplifying and recording equipment are provided for convenient mounting on a specially designed "unimount" tripod upon which the sound camera itself may also be set.

Origins and Purposes of Company Unions

Dr. Harry Elmer Barnes

Writing in the
SCRIPPS-HOWARD NEWSPAPERS

THE destiny of the New Deal may well turn about its ultimate attitude toward Clause 7A of the NIRA. which supposedly confers upon organized labor the right of collective bargaining.

While it is too early to accuse the government of having walked out from under its labor union commitments, it has certainly gone far enough in this direction to make the company union issue one of large current importance. Hence it will be worth while to know just what these are.

The late professor R. F. Hoxie, one of our leading authorities on American trade unionism, concisely and accurately defined company unions as "unions instigated and practically dominated by the employers, organized and conducted for the purpose of combating or displacing independent unionism."

Company Union Origins

The company union movement first started in Europe at the close of the nineteenth century, particularly in Germany and Great Britain. But the strength of the Social Democratic movement in Germany and of the Labor party in Great Britain prevented this development from gaining any considerable headway.

The company union movement in the United States dates almost exclusively from the period since the World War.

During the war the War Labor Board established shop committees for collective bargaining in more than 200 plants. At this time the American Federation of Labor was represented on the War Labor Board and fully intended that the shop committees would be dominated by trade unions.

This was exactly what the employers were determined to prevent. Taking advantage of the economic slump after the World War and of the decreased power of organized labor, they threw out these unionized committees and replaced them by company unions.

Of late years there has been a growing tendency to allow employes to vote upon whether or not they wish a company union, but this does not really make the union any stronger or more representative of the workers.

Labor Must Control Market

The inherent weaknesses of the company union as representative of organized labor are transparently clear to anyone at all familiar with the labor problem.

In order to negotiate effectively with an employer, labor must control a large portion of the labor market in any indus-

try. A company union at best controls only the laborers in a given factory. It is only one step better than the solitary individual in dealing with the corporate employer. The latter can bring in outsiders without number to take the place of striking employes.

The company union is devastatingly open to the possibilities of espionage and coercion by employers. The union meetings are almost invariably held in the plant and permit of easy spying by the employers or their stool-pigeons.

Other weaknesses are inherent in company unions. Limited by the perspective and resources of a single plant, they can formulate no such broad labor policies as can a national trade union. Nor can they produce trained and specialized negotiators capable of coping with adroit employers, their attorneys or both.

That the company unions are rarely, if ever, preferred by workers to broader trade unions is to be discerned in the fact that company unions have almost invariably developed only in industries where labor unionism has been effectively blocked.

Used as a "Front"

Yet workers prefer even this shadowy form of organization to nothing. This is attested by the fact that when Mr. Roosevelt came into office some form of company union existed in about 1,000 plants involving around 1,500,000 workers.

The company union, then, is a "front" exploited by employers in their battle against genuine trade unionism. Just to the degree that the federal government surrenders to the company union travesty, just that far will it lose the respect of realistic and informed students of labor problems and economic conditions.

Erratum

In our June issue it was erroneously reoprted[1] that the Western Electric reproducer had been adjudged by the U. S. Circuit Court of Appeals in Philadelphia to have infringed certain flywheel patents owned by the American Tri-Ergon Corp.

Western Electric was not a defendant in this case, the action being against two theatres having RCA equipment.

[1] "Tri-Ergon Wins Two Patent Decisions", p. 7.

British Theatre Wages Offer Interesting Contrast

THAT wage scale controversies between exhibitors and projectionists are not confined to America is demonstrated by the following excerpt from the *Journal* of the British Kinema Projectionists Guild, which provides an interesting contrast between working conditions in England and America:

"The Report of the Joint Conciliation Board of the London and Home Counties Branch of the Exhibitors' Association

came up for consideration at the May meeting of the London Court. The following are the recommendations of the Board as applied to projectionists and electricians:

"1.—The working week where projectionists and electricians work on a Sunday, 55 hours actual working hours per week. When there is no Sunday work, 60 hours per week.

"2.—*Overtime.* For all hours worked in excess of the weekly hours stipulated in this agreement, the employee shall be paid time and a half rate, with the exception of the provisions specified in Clause 4 hereof.

"3.—*Holidays.* Employees shall be entitled in each year of service to at least one week's holiday with pay.

"4.—*Sunday Opening.* Where a picture theatre is licensed for Sunday opening, all time worked on Sunday shall be paid at double rates of pay. Five hours shall be considered as the day's work for Sunday and be paid for at double-time rates. Christmas Day and Good Friday shall be reckoned as Sundays.

"5.—*Conditions of Engagement.* In all cases of employees (other than musicians) engaged on a weekly wage, the termination of the wage contract will necessitate a week's notice to be given either by the employer or the employee to terminate the contract or by a week's salary in lieu of notice.

"6.—Where the conditions or scale of wages are better than those stipulated in this agreement, they shall remain in force.

Applying to Projectionists

"(*a*) The chief projectionist must be a man of 21 years of age or over and shall be capable of the maintenance of the installations.

"(*b*) The second projectionist shall be a man of 19 years of age or over who has had practical experience in the trade. He shall be capable of taking charge of the operating box in the absence of the chief projectionist.

"(*c*) *Probationers or Learners.* The consideration of this Clause has been deferred until a scheme of apprenticeship in the cinema industry is put forward for discussion.

"In Class AA Halls.—1st, 2nd and 3rd projectionists: $26.50, $17.50, and $12.50, respectively, per week. 4th and 5th projectionists $7.50. Where a fully skilled electrician is employed as such, he shall be paid not less than $26.50 per week.

"In Class A1 Halls.—1st, 2nd and 3rd projectionists: $22.50, $15, and $9. per week.

"In Class A Halls.—1st, 2nd and 3rd projectionists: $20, $13.50, and $8.50 per week.

"In Class B Halls.—1st, 2nd and 3rd projectionists: $17.50, $12.50, and $7.50 per week.

"In Class C Halls.—1st, 2nd and 3rd projectionists: $15, $11.50, and $6 per week.

"The categories referred to as AA, A, B and C are those so designated in accordance with the rules of the Exhibitors' Association. The category style A1 is an intermediate category created by the Board for cinemas which, in the opinion of the Board, do not come either in the AA or the A category. The A1 category appertains to those cinemas with takings over $1500. weekly average per annum."

Incidentally, the Guild of Projectionists unanimously disapproved the foregoing schedules of wages and conditions and voted not to participate in any further joint conferences so long as the exhibitors continued to "exhibit" such a penurious attitude toward skilled labor.

PRE-FIXING PRINTS

(*Continued from page 7*)

on the film is magnified at the rate of 300 to 1 on a screened picture 25 feet in width; or a scratch on the film that is but 1/100 of an inch wide would show a streak or shadow 3 inches wide on the screen.

Scratches in the emulsion of the sound track will result in diminished or altered sound reproduction.

Warping, curling or buckling of film is caused by the uneven withdrawal of moisture from the emulsion, and when these effects are present to an appreciable degree, it is impossible to hold the image on the screen in proper focus. The focus is controlled entirely by the fixed distance of the film from the focusing lenses

in the projector; any alteration in that distance, even in the slightest degree, disturbs the focus of the screen image.

If a film becomes warped or buckled to the degree that the effect of "in and out of focus" results during projection, there is little chance of correcting the condition and the film is unfit for further service. An analogous situation prevails in the proper transmission of sound with a warped or buckled film.

Brittleness of film is nearly always due to a condition of the emulsion, since the celluloid backing is rarely appreciably affected by the different atmospheric conditions under which, normally, motion picture film is used or stored. The emulsion of film tends to take up or lose the moisture depending on the relative humidity of the air in which it is kept.

To maintain pliability in film it is necessary to keep a certain minimum humidity in the surrounding air, so it will not dry out excessively; or to so impregnate the emulsion of the film with a fixed chemical as to provide a permanent pliability not affected by the changes in the relative humidity of the air in contact with the film.

New film can be seasoned by a buffing process; it is a hazardous operation depending upon friction heat to remove part of the moisture from the gelatine and thus harden it. Buffing often leads to abraded gelatine surfaces, embossed high lights which appear when the film is put in service, and a premature brittleness that materially shortens the life of the film.

Edge-waxing of new film will, if properly done, eliminate the evil of emulsion-depositing. It will not, however, eliminate the damage resulting from brittleness, warping, buckling, scratches or "rain."

The damages to new film as outlined, with the possible exception of brittleness, occur nearly always in the projection room usually during the first runs of the film. Booking schedules on subjects first released require reasonable assurance of non-interruption from physical damage to the prints, because early playing dates bring in big revenues.

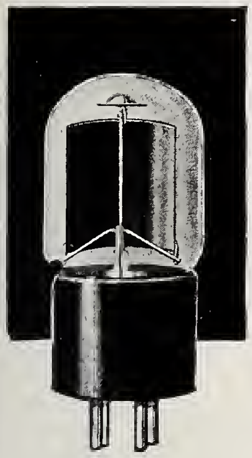
To protect films from such damages and to offer assurance of non-interrupted schedules, this writer believes that new film should be treated at the laboratory, before it is shipped, in the following manner:

(1) The emulsion should be so fixed over its entire area that no deposits will accumulate on the tension shoes at either the aperture plate or the sound gate of the projector. The perforation area and the sound track should be so treated that new film will pass through the projector the first time with all the freeness of seasoned film, thus protecting it against pulled, torn or strained perforations. Such treatment must offer no interference to the proper pick-up and transmission of the sound.

(2) The emulsion should be so treated over its entire area that it will be toughened and resist scratching to the maximum degree possible; thus assuring a clear image on the screen.

(3) The gelatine or emulsion should be so impregnated with a suitable fixed chemical that the film will stay in its original flat condition regardless of the quick or uneven withdrawal of moisture when it is subjected to the heat from the projection lamp.

(4) The emulsion should be treated in such a way that the original pliability will be maintained, regardless of the low humidity of the air in which the film may be used or stored.



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Edited by James J. Finn

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MONTHLY CHAT

M. H. AYLESWORTH, head of National Broadcasting Co., announces that television still is "five years off". This five-year term has been used steadily for the past five years. We often wonder why these prognosticators of things technical don't spill the real lowdown on television.

What is it? Just this: television could be readied within a year; but the big dough boys, who let radio get away from them and slip into the non-paying entertainment class, don't intend to be caught napping with television. Just as soon as some means is devised for making the consumer, meaning the listener, pay for the service, then just so soon will television emerge from "the laboratory."

TESTS of a new condenser reveal a 50% improvement over the best existing types. In line with the usual policy of this business, everybody, including the manufacturer, is saying nothing about this development. You see, it's a secret. This shush-shushing should make for a fine promotion job.

THE future of the new A. C. arc, concerning which much type has been used in these columns, is tied-in tightly with a good arc control. This has been our stand since this arc type was announced. Most lamps are alike; but putting over the A. C. arc depended entirely upon accurate arc control.

Well, we finally have seen an arc control that we think will do the trick. More about this control shortly.

NO industry is more indebted to and dependent upon technological progress than is that of motion pictures. And no other industry, as a whole, pays so little attention to technical matters. Thus, whatever the ultimate outcome of the current Tri-Ergon patent activity, the fuss at least will serve to focus industry-wide attention upon factors other than the box-office.

We haven't noticed the citation of this particular slant anywhere else, but we'll stick to this view.

INDICATIONS are multiplying that the industry trade papers, who beat the drums long and loudly over the possibilities of theatre modernization through federal loans, have grabbed another hot iron only to let go quickly. This story, mishandled from the start, sent hundreds of exhibitors and not a few manufacturers on a willy-ninny spasm of enthusiasm.

The plain truth of the matter now and at the start of all this noise is that no part of any such loan can be used for any movable equipment—which takes in the projection room complete. The story, plus the endless pretty charts, didn't look badly in print, however.

INTERNATIONAL PROJECTIONIST

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OCTOBER 1934

BRUSHES: A VITAL LINK IN M. G. MAINTENANCE

M. L. Robinson

THE purpose of this article is to give users and maintenance men a better understanding of the selection, care, manufacture and application of brushes used in standard motors and generators. There are too many people who regard brushes as plain pieces of carbon, and when new brushes are needed, use anything they can get. This usually results in plenty of trouble and expense later on.

The design, manufacture and application of brushes is a very skilled technical procedure requiring extremely high engineering ability. The next time that anyone feels tempted to use a set of brushes out of the "miscellaneous" box this statement should be kept in mind.

The manufacture of a popular make of brush requires 36 major manufacturing operations which take 65 days. There are about seven classifications of brushes:

Copper Leaf and Gauze—This class of brush is practically obsolete. *Low Grade Carbon Graphite*—This brush has a low ampere carrying capacity, is usually abrasive and is limited in use to machines with low peripheral speed commutators where strength and abrasiveness are important.

High Grade Carbon Graphite—This type of brush is very popular and has a wide range of uses, has medium friction and is composed of carbon and graphite. *Carbon Graphite*—This brush is impregnated with lubricating material and is not very popular because it has a number of bad features such as a tendency to stick in the brush holder and to "gum" up a commutator.

Electro Graphitic—A brush of this type is made by a high heat treatment process which increases the carrying capacity and lowers friction. A brush of this type is popular for use with undercut commutators and is usually unabrasive.

Selection of Brushes

Graphite—Natural or artificial graphite is used in this grade of brush which has a high ampere carrying capacity, medium contact drop, is soft, requires low spring tension. It is used for high amperage, high speed, low or ordinary commercial voltage apparatus and for use on 2200 volt slip rings. *Metal Graphite*—This is a widely used brush and is made of a copper powder and graphite. Such a brush has a low contact drop and is used on low voltage commutators or slip rings carrying high currents.

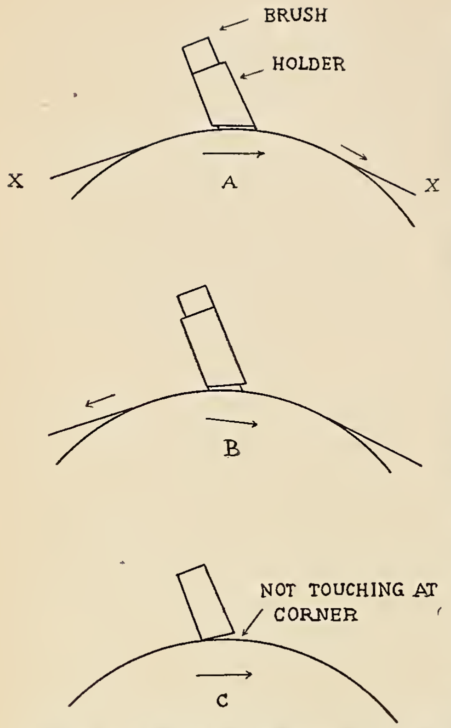
In determining the type and grade of brush to be used for a machine there are ten factors to take into consideration—namely, capacity, contact drop, friction riding ability, resistance, strength, hardness composition and surface speed. These factors readily explain why it is vitally important to use the grade of brush recommended by the manufacturer of either the machine or the brushes.

The specific resistance of a brush is the ohms per inch cube and depends upon the materials used and the process of manufacture. Carrying-capacity of a brush is the current in amperes which one square inch of brush surface on a commutator will carry under normal conditions, without causing the temperature of the brush to rise more than 50 degrees C. When a brush is used on slip rings or for intermittent service on commutators, the rating can be increased from 25 to 40%.

Peripheral speed varies with the grade of brush and is given in feet per minute.

Hardness of a brush is its ability to withstand pressure and does not bear any relation to abrasiveness. An instrument called the scleroscope is used for determining hardness. This is measured by the height of rebound of a steel ball dropped from a fixed height upon the brush.

Contact drop is the voltage drop be-



Showing proper brush fitting. There is a slight amount of play between the brush and its holder, so that it will not stick. The arrow within the curved line shows the direction of rotation of the armature, the curved line representing the commutator.

The brush touches the lower part of the holder at the right, while at the upper end it touches the holder at the left. X represents the strip of sandpaper.

When the sandpaper is drawn in the direction shown by the arrow above it, the brush is pulled into the same position as it occupies during normal operation of the machine, and this fit will be right. If the paper be drawn the other way, as shown at B, the brush is tipped the opposite way in the holder, consequently changing the angle it makes with the commutator.

If the brush would stay in this position when in normal operation, everything would be in order; but when the machine starts, the brush assumes the position as at A, with the result that the face of the brush does not fit the commutator. This is shown at C. Not only will this cause overloading of the brush, as a small area has to carry the current that the entire brush is supposed to carry, but it will cause sparking and improper commutation.—A. C. Schroeder.

tween the commutator or ring and the brush. A medium voltage drop for a positive plus negative brush is 1.2 and 1.8 volts.

Abrasiveness is the degree of surface wear of commutators and rings. Commutators with hard mica, not undercut, and machines with poor commutation require abrasive brushes. Bright polish on a commutator is an indication of an abrasive action, while dark gloss indicates good commutation. Non-abrasive brushes should be used with undercut commutators.

Brush pressure is given in pounds per square inch of contact surface. Tension or brush pressure, is an extremely important factor in the life of a brush. In general it is best to use the lowest pressure that will give good contact, but never less than 1¾ lbs. per square inch, except with some grades of graphite brushes.

When large metallic brushes are used, more spring tension must be applied to the brushes on the underside in order to compensate for the weight of the brushes.

The bevel of a brush is the angle included between the bevel face of the brush and the plane at right angles to the length of the brush. Bevels vary by steps of 5 degrees. The length of a beveled brush is the length of the square ended brush from which the beveled brush was made. "End" bevels on a brush are known as "contact face bevel" and "spring end bevel."

The running angle of a brush is its position on a commutator with reference to the direction of rotation and is classed as "trailing", "leading" and "radial".

Shunts or "pigtails" are flexible copper leads securely fastened to the brushes. Failure of these shunts to carry the current causes brush holder springs to lose their temper and burn off. Brush holders become pitted and sparking may occur. Copper plating of brushes with shunts is for the purpose of lowering the voltage drop between the brush and the shunt and to maintain this condition.

Length of a brush is the maximum overall dimension in the direction in which the brush feeds to the commutator or collector ring. Width is the dimension at right angles to the length and to the direction of rotation. Thickness of a brush is the dimension at right angles to the length in the direction of rotation.

Flexibles, shunts or pigtails are attached to brushes (except those used on clamp-type holders), for the purpose of carrying most of the current passing through the brushes—preferably all of it. If a shunt was not used, the current would go through the holder and the finger spring. This would very likely cause arcing which would result in injury to both the brush as well as the spring.

There are several different methods used for fastening shunts to brushes such as: bolted, screwed, soldered, spun rivets, cemented and with wedges inserted in holes drilled in the brushes. The separate type of pigtail is rarely used any more as the other methods are better.

On some of the softer grades of carbon graphite and graphite brushes, metal clips are fastened over the top so as to prevent wear from the pressure fingers.

PROJECTIONS

***By* Frank Dudiak**

MANY important projection problems will be considered during the Fall Meeting of the S. M. P. E., outstanding among which is the question of reel length. Fortunately, the sessions will be held in New York City and are assured of a strong projectionist representation.

In its report of last Spring the Projection Practice Committee of the Society went on record as being absolutely opposed to the proposal of standardizing the 1,700-foot reel, as was suggested, for the reason that with a 1,700-foot maximum length the average length would be less than 1,500 feet, or possibly even 1,350 feet. Thus, said the Committee, the doubling of reels would continue as before.

Modern projectors are equipped with magazines which can accommodate more than 3,000 feet of film, thus it is necessary that any single reel be of such length as to make impossible its doubling, or joining, with another reel. It would appear that the Committee is perfectly right in taking a determined stand in favor of the longer basic length.

Publication recently of the membership roster of the S. M. P. E. reveals a steady growth in projectionist membership. Under the new rules, projectionists may become associate members of the Society for as little as $6 a year, or 50c a month. The *Journal* which is sent monthly to each member alone is worth this investment.

One projectionist approached another with the following question: In the projector in question, approximately how many more revolutions is the reel in the upper magazine making *per second* when the diameter is six inches than it would if the diameter were ten inches? The answer to this little poser will appear in our next column.

[HINT: The circumference of a circle is found by multiplying the diameter by 3.15, or the radius by 6.3.]

Constant attention is necessary to minimize noise originating in the sound system. Dirty or corroded tube prongs are consistent troublemakers, causing a noise like rippling water or a loud crackling to issue from the horns.

If the noise be caused by the tube prongs making poor contact, the trouble likely will be found in the most sensitive tubes in the system When the faulty tube is located, the prongs and tube socket should be cleaned with an ink or pencil eraser (not with sandpaper or other abrasive), after which they should be wiped with a cloth dampened with carbontetrachloride.

When a man becomes chesty and orates on his knowledge of projection from A to Z, his listeners mentally interpret the range as being from A to B.

The Industry Re-Discovers Mr. Fox and Tri-Ergon

James J. Finn

NO other industry, save possibly that of automobiles, is so dependent upon technological progress as is that of motion pictures. Yet the picture industry is what might be charitably termed a technical bum, in the sense that it knows neither the whys nor the wherefores of the technical aspects of the art. Essentially a business of ballyhoo and false front, the industry has ever been prone to water the leaves and ignore the roots.

The enormous amount of punishment absorbed by the industry in the process of adapting itself to sound pictures is sufficient proof of the foregoing. And the end is not yet.

Thus, when the Tri-Ergon patent mess, brewing for years but ignored by the "best minds" in this field, burst full force upon it, the industry was totally unprepared to sustain such a shock. How could something concerning which they knew nothing deliver such a crushing blow? Even now, after the Tri-Ergon chickens have come home to roost, the industry is enveloped in a haze of doubt, fear and speculation, created largely by much misinformation fed to it supposedly on the inside.

The Tri-Ergon Background

The background of the Tri-Ergon patents must be sketched briefly before one can appreciate the existing situation. What are the Tri-Ergon patents?

They comprise a group of 23 patents which reflect the technical abilities of three Europeans, by name Hans Vogt, Joseph Massole and Josef Engel. Swiss Tri-Ergon Co. was formed, in Switzerland, to hold these patents. Subsequently this company sold to William Fox, then head of Fox Film Corp., a ninety per cent *stock interest* in the American rights to these patents. American Tri-Ergon was formed in this country. Fox is reported to have agreed to promote the use of Tri-Ergon equipments in this country within a specified time limit, since twice extended. Thus, it appears that Fox holds not an *ownership* right but merely a *promotion* interest in the patents, his revenue ostensibly to come from the leasing of equipments in America. This is a moot point; and Fox is saying nothing.

Of interest is the fact that along about 1926 the 23 Tri-Ergon patents were hawked on numerous counters in America, the absence of any takers ultimately forcing the price down to a reported $1,500 apiece, which is what Fox is said to have paid for them. Many large companies looked into the patents, RCA and Western Electric included, but evidently considered them of little value.

William Fox thought otherwise, and he bought. Later on came the terrific battle for control of Fox Film Corp., the end of which saw Fox out on the street through a "settlement" reputedly involving his receiving $500,000 annually —plus the Tri-Ergon patents, to which scant attention was paid. Fox never denied that he used Fox Film Corp. money to purchase the patents, which circumstance leads to the report in certain quarters that the latter will now contest the ownership of the patents. Fox, on the other hand, holds that the failure of Fox Film Corp. to pay him any part of the promised annuity of $500,000 gives him title, free and clear, to the patents, even though bought with money from the till of the corporation which he headed.

It isn't at all necessary to read between the lines in the book "Upton Sinclair Presents William Fox," published three years ago, to learn that Fox, who admittedly supplied the data to Sinclair, took leave of Fox Film Corp. nursing anything but kindly feelings for those who, he asserted through Sinclair, "engineered" his precipitate departure from motion picture activities. Fox displayed a particular peeve against Electrical Research Products.

Once out of Fox Film Corp., Fox turned loose his vast energy on the task of regaining his place in the industry —through the medium of the Tri-Ergon patents. Fox has done a good job with Tri-Ergon. The well-informed never doubted that the patents possessed, at the very least, a vast potential nuisance value. The present writer takes a bow, having said more than three years ago:

> "Some day not far off the motion picture industry will regret having glossed over the Tri-Ergon patents, now held by William Fox . . . It is all right to boast of patent protection and to pooh-pooh the 'miserable' patents in this pool, but the effect of a successful patent foray by William Fox will jar this industry to its toes . . .
>
> "Outstanding among the Tri-Ergon patents is the so-called flywheel patent, which device is used by practically every worth while sound reproducing system . . . It wouldn't surprise us at all if this particular patent ultimately is adjudged valid . . ."

After a few preliminary skirmishes, Fox launched a stiff patent offensive against Paramount on the double-print process (defended by Erpi), and against certain Pennsylvania theatres on the use of the flywheel (defended by RCA). Of particular interest to the reproducing field is the latter patent, U. S. 1,713,726, issued on May 21, 1929, to Hans Vogt.

The aforementioned actions were fought through the courts, and finally the U. S. Supreme Court refused to review a decision by the U. S. Circuit Court of Appeals which held the Tri-Ergon patents to be valid. What does this mean?

Significance to Industry

In the case of production it means that the process of simultaneously recording sound and picture on separate negatives and the simultaneous printing of the same on one print is covered by the Tri-Ergon patent now adjudged valid. When a patent is held to be valid, does this also mean that it is held to have been infringed? The answer is NO. Infringement is something still to be proved by Fox, and this he has already set about doing by filing suits, involving accountings, against certain major producers and laboratories.

What if the Tri-Ergon double printing patent be adjudged infringed? Fox could then force an accounting on back royalties covering the period during which the process was used, and he could proceed to write his own ticket for future use of the process. Erpi is generally regarded as having contractually guaranteed patent protection to its producer licensees, and if this be

so (and Erpi hasn't denied that it is so), then it appears that damages, if any, would have to come out of the Erpi till.

Is it possible to get around the double-printing patent? The answer is YES. At the disposal of Erpi producer licensees is the disc recording system developed in Bell Telephone Laboratories and so ably demonstrated by Halsey Frederick of the Bell staff. The trick would be to first record on disc and then re-record the sound on film. It happens that two recent pictures, "One Night of Love" (Columbia) and "Enter Madame" (a forthcoming Paramount release) were both recorded by this means. The sound is better than good, with background noise absent.

This disc process, commonly known as vertical-cut recording (or as the hill-and-dale method) has been the subject of extended raves in these columns, in addition to a complete technical description.[1]

There is a possibility, of course, that Fox and the industry may get together and agree on some settlement overall, but not much hope is held out for this eventuality.

Much the same situation exists with respect to the flywheel patent, also held valid but the infringement of which must be proved. Fox has moved quickly on this patent, too, with Loew and Warner already the victims of his legal thrust in the form of accounting actions. Erpi has made the rather fine distincttion that the original Fox action on the flywheel patent did not refer to any Erpi exhibitor licensees, but now that Loew and Warner are in the legal soup, the flywheel matter becomes very much Erpi's business.

Erpi made no statement following the Fox legal victory, but it did send to all exhibitor licensees a letter which promised patent protection to all exhibitors who were not in default on payments, and counselled quick action in notifying Erpi of any interference with the operation of theatre sound equipment.

Erpi's Flywheel Substitute

Tests are now in progress in several New Jersey theatres of a means for eliminating the flywheel from sound reproducers. The Erpi solution is known to comprise a train of gears which, they feel, will satisfactorily solve the flywheel problem. It is estimated that it would cost Erpi in the neighborhood of $500,000 to eliminate the flywheels on existing theatre sound equipments. This would not affect the right of Fox to sue for infringement damages on the use of the unit to date.

The situation would not be so difficult if it were merely a case of Fox instituting accounting actions for infringement of the flywheel patent, because such a case likely would drag on and on through the courts for possibly two years or more, during which time the industry would have a breathing spell. But such legal procedures inevitably include a request for an injunction, and herein lies the danger. The granting of such an injunction would tie up the industry tighter than a knot. That any court would issue before trial of the issues involved so drastic and sweeping an injunction and thus paralyze a great industry is seriously doubted in well-informed quarters. Still, there exists that possibility; and defiance of an injunction in contempt of court is the one sure way to break into the hoosegow.

Should the injunction be denied and the case go to trial, nothing of importance other than a settlement would be likely to occur for a couple of years —and the passage of that much time might induce a settlement of one sort or another.

Thus one side of the legal battle over Tri-Ergon. The other side concerns the reported intention of the Swiss Tri-Ergon to combat Fox's claim that he owns the American Tri-Ergon rights, the story here being that the European group may seek to move Fox out on the ground that he failed to promote the sale of Tri-Ergon equipments in this country as originally agreed, and on which the time limit has been twice extended.

Another report has it that those holding the remaining ten per cent of stock in American Tri-Ergon will either join hands with the parent company or essay a legal foray on their own in an effort to eliminate Fox. The possibility of a bargain being struck between the European parent company and producers, sound companies and exhibitors in America is not remote.

Then there is the story that Fox Film Corp. will claim ownership of the American Tri-Ergon rights on the grounds that William Fox paid for the rights with money from the Fox Film Corp. till. Should this happen, Fox Film Corp. will be obligated to turn over the rights to Erpi under the terms of an existing agreement relative to patent rights or developmental work. This shapes up as a bit far-fetched, however.

Still, if by some means Erpi should come into control of the Tri-Ergon patents, it would do RCA not one whit of good, despite reports to the contrary appearing in an industry trade journal. Cross-licensing as between Radio Corp. of America, American Telephone & Telegraph and General Electric was wiped out under the terms of the consent decree entered in the Wilmington, Del., government suit against these companies for alleged violation of the anti-trust laws. Cross-licensing simply doesn't exist.

Thus the picture of the Tri-Ergon mess. It isn't a pretty picture, but its hues are particularly pleasing to scores of lawyers who are preparing for a Roman holiday at the industry's expense. Everybody but the lawyers is bound to lose—heavily.

Patent Racketeering

There exists in certain quarters the feeling that in vigorously pushing his patent claims William Fox is playing the role of arch-villian, the threat sinister to the picture business. That Fox needs no special pleader is obvious, but it may be said that patent racketeering, rampant for years in both the sound picture and radio fields, was not conceived by William Fox. It merely happens, as we see it, that Fox, having studied at the feet of the masters in this art, simply learned his lessons much too well to suit his teachers. The expertness displayed by Fox in his current legal moves was born of long, and possibly bitter, experience—while he was on the wrong side of the fence.

In passing, we should like to record our conviction of long standing that patent practice as followed throughout

(*Continued on page* 25)

[1] "Effect Vast Improvement in Disc Reproduction", H. C. Harrison, Jan., 1933, p. 20.

RCA Promises Protection; To Modify Equipments

Full patent protection, plus a modification of existing equipments, is promised to all RCA exhibitor licensees in a letter sent out over the signature of E. T. Cunningham, president of RCA Victor Co. The letter, in part, follows:

" . . . we reaffirm that we assume the full measure of responsibility undertaken by us under our contracts. Accordingly, we are preparing to modify all infringing soundheads installed in theatres operated by our customers so that they will not infringe. The expense involved in this work will be borne by the RCA Victor Company.

"Some replacement parts are now available and additional quantities are being manufactured. To insure prompt installation our service force is being increased. District Service Managers will contact all customers operating infringing devices and arrange for necessary modification promptly.

"We request you to give us prompt notice by wire, with full information thereafter by mail, of any action, by suit or otherwise, affecting the use of reproducing equipment furnished by us."

Answers to Problems, Lesson X

MATHEMATICS FOR THE PROJECTIONIST

WHILE it cannot be said that the number of answers received to the final installment helped to close out the series on mathematics in any blaze of glory, it certainly can be said that the quality of answers received was far above the average.

A term like "simultaneous linear equation", if hurled at projectionists generally a year or so ago, would have meant but little; yet now pop up any number of men who not only understand the term but actually work out such problems. As for those who continue to shy at even a simple mathematical problem—well, they simply must plod along and be barred from appreciating enormous quantities of good stuff that just can't be properly explained without a few equations; not to mention the fact that the series now closed should serve to impress upon them how precious little they know, how much there is to learn.

As was to be expected, practically the same group of old-timers came through once more with fine sets of answers. Among these were Dale Danielson, Joe Uebelhoer, one of the most painstaking students of the group; Harold F. Miller, a newcomer from Chicago who knocks over the final group in a manner which suggests that he knows what it is all about; Frank Dudiak, who now mixes projection with courses at West Virginia U; Howard Williams, Edward Regula and Raymond Mathewson, who put New Britain, Conn., on the map with a joint set of answers; Edward Burke, who didn't quite reach 100% but who made a swell job of the series generally; Sam Barr and Mason Sperling.

Also, Joe Barnett, with another clean, crisp effort; G. L. Cummings, John Fegan, Ralph Welling, Clifford Newton, and Otis Clarke. Not a few others who plugged along right through the series—their only reward the satisfaction of seeing each month how wrong they were—would receive mention herein if space permitted. These participants probably got far more out of the series than did those to whom the problems came more or less naturally.

Appended hereto are the answers to the problems, together with a graphical solution of Problem 5:

1. Solve the following by the method of substitution:

$$5x+6y=27$$
$$x+7y=17$$

Answer

Solving:

$$x=17-7y$$

Substituting this value for x in equation (1):

$$5(17-7y)+6y=27$$
$$85-35y+6y=27$$
$$-29y=27-85$$
$$-29y=-58$$
$$-y=-2, \text{ or}$$
$$y=2$$

$$5x+6y=27$$
$$5x+12=27$$
$$5x=27-12$$
$$5x=15, \text{ or}$$
$$x=3$$

2. Solve the following by addition and subtraction:

$$2x-3y=11$$
$$3x+y=22$$

Answer

Multiplying equation (2) by 3:

$$9x+3y=66 \quad (3)$$
$$2x-3y=11 \quad (1)$$

Adding (1) to (3):

$$11x=77, \text{ or}$$
$$x=7$$

Substituting this value for x in (1):

$$2\cdot7-3y=11$$
$$14-3y=11$$
$$-3y=11-14, \text{ or } -3$$
$$y=1$$

3. Solve the following by the method of substitution:

$$9x+y=21$$
$$x+9y=29$$

Answer

$$y=21-9x$$

Substituting this value for y in (2):

$$x+9(21-9x)=29$$
$$x+189-81x=29$$
$$-80x=29-189$$
$$-80x=-160$$
$$x=2$$

Substituting this value for x in equation (2):

$$x+9y=29$$
$$2+9y=29$$
$$9y=29-2$$
$$9y=27$$
$$y=3$$

Answer

4. Solve the following by addition and subtraction:

$$5x+6y=27$$
$$x+7y=17$$

Answer

Multiplying (2) by 5:

$$5x+35y=85 \quad (3)$$
$$5x+6y=27 \quad (1)$$

Subtracting (1) from (3):

$$29y=58$$
$$y=2$$

Substituting this value for y in equation (2):

$$x+7y=17$$
$$x+14=17$$
$$x=17-14$$
$$x=3$$

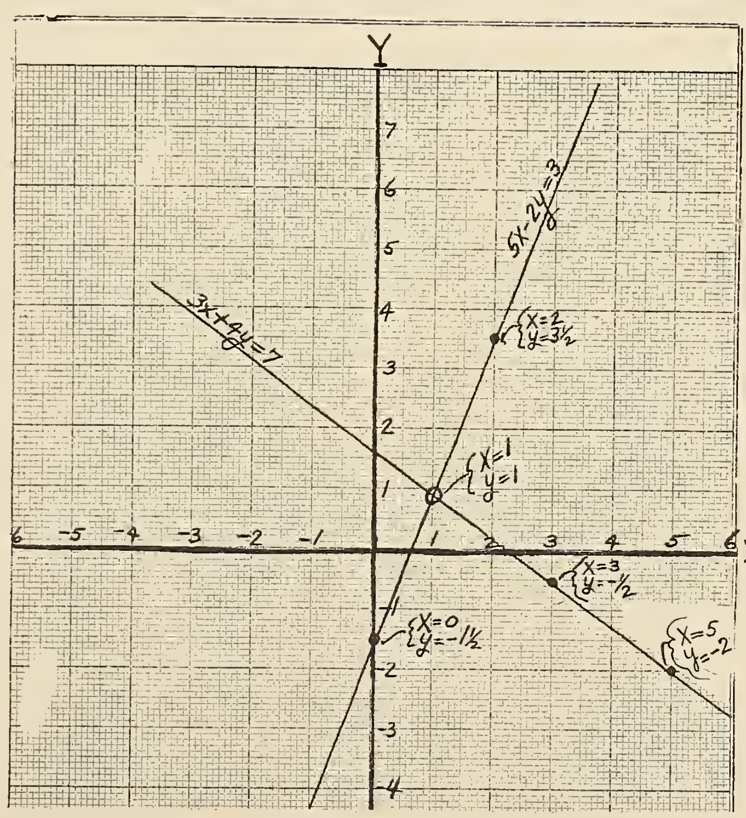
5. Solve the following by the graphical method:

$$3x+4y=7$$
$$5x-2y=3$$

Answer

Graphical solution appears below

(*Continued on next page*)



Graphical solution to Problem 5

6. Solve the following by the method of completing the square:

$$2x^2+8x=64$$

Answer

$$2x^2+8x=64$$
$$x^2+4x=32$$

$x^2+4x+4=32+4$ (adding the square of one-half the coefficient of x)

$x+2=\pm 6$ (Extracting the square root of both sides of the equation)

$x=-6-2$ or -8 (Using the -6 root)

$x=+6-2$ or $+4$ (Using the $+6$ root)

7. Solve the following by the quadratic formula:

$$x^2+4x-32=0$$

Answer

$$x=\frac{-6\pm\sqrt{6^2-4ac}}{2a}$$

$$x=\frac{-4\pm\sqrt{16-4\cdot 1\cdot(-32)}}{2}$$

$$x=\frac{-4\pm\sqrt{16+128}}{2}=\frac{-4\pm\sqrt{144}}{2}=\frac{-4\pm 12}{2}$$

$$x=-8, \text{ or } +4$$

Important Projection Listed Topics on S. M. P. E. Convention Program

PREPARATIONS have been completed for the Fall Meeting of the Society of Motion Picture Engineers to be held at Hotel Pennsylvania in New York City, October 29-November 1. The tentative papers program, appended hereto in part, lists a wealth of material which will both chart the technical progress of the industry during the past six months and stake out the course for the future.

The forthcoming convention will be a landmark in Society history in that it will witness the retirement as president of Dr. A. N. Goldsmith, under whose leadership the Society has made rapid progress in addition to having undergone a radical change in its structure and *modus operandi*. Particularly noticeable during the past few years has been the extreme interest in the projection field exhibited by Dr. Goldsmith.

H. G. Tasker, of United Research Corp., being unopposed for the office of president, will succeed Dr. Goldsmith. Other officers will also be elected on the opening day of the meeting.

Among those who will address the Convention at various times through the meeting are Ed Kuykendall, president of the M. P. T. O. A., and Mrs. Frances T. Patterson, Columbia University—both of whom will speak at the get-together luncheon on opening day. At the banquet on the evening of the third day the speakers will be Dr. F. B. Jewett, vice-president of American Telephone & Telegraph Co., and Harold B. Franklin, stage and picture producer.

Interesting Projection Topics

Projection topics will come in for a major share of attention, outstanding among which will be the report of the Projection Practice Committee, headed by Harry Rubin, who will present a paper on the new Suprex D. C. arc lamps, while the National Carbon Co. will offer a paper on "The Non-Rotating High-Intensity D. C. Arc for Projection", by Messrs. Joy and Geib. These papers, plus the inevitable discussions, are expected to go far toward clarifying the present arc situation.

Dr. Goldsmith will also read a paper at the projection session. N. Levinson of the Academy of M. P. Arts and Sciences will describe the activities of the Research Council of the Academy, which is presently engaged in various technical projects affecting the projection and exhibition fields. Not a little advance interest is being manifested in the paper, "Reflecting Surfaces of Aluminum," to be read by a representative of the Aluminum Co. of America.

The highlight of the social program will be the semi-annual banquet which this year falls on Halloween evening. Numerous other social activities, particularly those for the ladies, have been arranged.

Among the papers listed for presentation at the meeting are:

"The Theatergoer's Reaction to the Audible Picture as It Was and Now"; M. Hall.

"Current Developments in Production Methods in Hollywood"; H. G. Tasker, United Research Corp.

"The Production Situation in Russia"; V. I. Verlinsky, Amkino Corp.

Report of the Standards Committee; M. C. Bastel, Chairman.

Report of the Historical and Museum Committee; W. E. Theisen, Chairman.

"Some Photographic Aspects of Sound Recording"; C. E. K. Mees, Eastman Kodak Co.

"Determination of Distortions in the Photographic Recording of Sound Tracks"; G. L. Dimmick, RCA Victor Co.

"Piezoelectric Loud Speakers"; A. L. Williams, Brush Development Co.

"Wow Measurements"; E. D. Cook, RCA Victor Co., Camden.

"The Photographic Disk Reproducer"; E. D. Cook, RCA Victor Co.

"Activities of the Research Council of the Academy of M. P. Arts and Sciences"; N. Levinson, Hollywood.

"Possibilities of Engineering Developments in the Motion Picture Industry"; A. N. Goldsmith.

Report of the Projection Practice Committee; H. Rubin, Chairman.

"Some Engineering Aspects of the Designing of Motion Picture Theatres"; B. Schlanger, New York; S. K. Wolf, Electrical Research Products, and L. A. Jones, Eastman Kodak Co.

"Electronic Tube Control for Theater Lighting"; J. R. Manheimer and T. H. Joseph, E-J Electric Installation Co., New York.

"Theater Luminous Architecture"; C. M. Cutler, General Electric Co.

"The Non-Rotating High-Intensity D-C Arc for Projection"; D. B. Joy and E. R. Geib, National Carbon Co.

Report of the Color Committee, C. Tuttle, Vice Chairman.

"Trick Photography"; J. A. Norling, Loucks & Norling, Inc.

"Rear Projection for Process Photography"; G. G. Popovici, Eastern Service Studios, Inc, and H. Griffin, International Projector Corp.

"The 16-Mm. Sound-Film Outlook"; W. B. Cook, Kodascope Libraries, New York.

"Sixteen-Mm. Optical Systems"; G. Mili, Westinghouse Lamp Co.

"What Is Light?"; S. G. Hibben, Westinghouse Lamp Co.

"High-Intensity Mercury and Sodium Arc Lamps"; L. J. Buttolph, General Electric Vapor Lamp Co.

"The Use of the High-Intensity Mercury Vapor Lamp in Motion Picture Photography"; M. W. Palmer, Motion Picture Lighting and Equipment Corp.

"Recent Developments in the Use of Incandescent Lamps for Color Motion Picture Photography"; R. E. Farnham, General Electric Co.

"Reflecting Surfaces of Aluminum"; J. D. Edwards, Aluminum Co. of America.

COAST ACTORS SET FOR A. F. OF L.

Screen Actors Guild, composed of film players in Hollywood, has voted to affiliate with the American Federation of Labor. Charter for the film field is now held by the Actors Equity Association, which has long controlled the legitimate field. Some Guild members hold that this concentration of Equity in the stage field makes desirable a direct charter for the Hollywoodians.

It is not considered likely, however, that Equity will permit this invasion of its jurisdictional rights, and the Guild is expected ultimately to join with the former under some local autonomy setup. Several years ago Equity participated in an abortive attempt to organize West Coast film players, with rumor having it that the then I. A. President William F. Canavan worked hard behind the scenes to jam the matter through.

Even though all Guild members, numbering Hollywood's most important players, should join Equity under A. F. of L. auspices, it doesn't shape up as of much importance to I. A. members.

CHARACTERISTICS AND USES OF THE CARBON ARC*

W. C. Kalb

The high efficiency of the carbon arc, the flexible and uniform quality of radiation it provides, and its extremely high intrinsic brilliancy give it a prominent place in the broad field of illumination. Characteristics of the various types of carbon arcs and their applications are outlined in this paper.

This paper and the accompanying illustrations are published here through the courtesy of the American Institute of Electrical Engineers.—Editor.

FIG. 1. D. C. neutral-core arc

THE carbon arc has passed through many interesting phases of development influenced by many factors of varied character. In early types, the street lamps of the "gay nineties", solid electrodes of coke composition, usually copper coated, were burned without protection from the air. Subsequent enclosure to prolong the burning period called for a reduction of the ash content of the electrodes and led to the development of the lampblack carbon.

Steadiness of the light was improved greatly by the introduction of a center core of softer neutral composition which stabilizes the arc stream and prevents it from shifting about the rim of the crater. Further improvement was effected for certain types of lamps by the introduction of a metal-coated negative carbon considerably smaller in diameter than the positive carbon.

Neutral Core Carbon Arc

Light from the solid or neutral core carbon arc operated on direct current comes almost entirely from the crater of the positive carbon. Little light is emitted from either the arc stream or the tip of the negative carbon. The light has a bluish tint with a strong band of ultra-violet radiation just outside the visible range.

In Fig. 1 is reproduced a photograph of the direct-current arc with neutral cored positive electrode operated in the position shown in Fig. 2. This illustration clearly shows the positive crater as the principal source of light, and its brilliancy indicates the reason for the early popularity of this light source in motion picture projection.

The relatively high output of blue, violet, and ultra-violet radiation gave the carbon arc early popularity as an artificial source of illumination for photography, the emulsions then in use having little or no sensitivity to yellow, orange and red. The carbon arc also attained extensive use in blue printing and photo-engraving, and the high-current direct-current arc was used by Finsen in his pioneer work in artificial light therapy.

The A. C. arc with neutral cored carbons is not as efficient as the D. C. arc, for while the craters of the carbon electrodes are still the principal sources of light, their brilliancy is far less than that of the positive crater of the D. C. arc.

In earlier applications of the carbon arc to motion picture projection, an inclined vertical "trim" was used as indicated in Fig. 2. The condenser lens in these lamps picks up a solid cone of light of approximately 45 deg. The crater is formed partially on the side of the carbon so as to present as large an effective area as possible to the condenser lens.

Considerable attention on the part of the projectionist is required to maintain the proper crater formation and position in this type of lamp. In large theatres positive carbons as large as 1⅛ in. in diameter have been used with 17/32-in. copper-coating negative carbons and arc currents as high as 140 to 150 amps. The low-intensity carbon arc still is used in searchlights for spectacular illumination.

D. C., L. I. Reflector Lamp

Development of the reflector arc lamp added greatly to the efficiency of the low-intensity neutral-cored carbon arc in motion picture projection, increasing the

*This paper has been approved by the Committee on the Production and Application of Light, American Institute of Electrical Engineers, and is scheduled for discussion at the winter convention of that organization to be held in New York, Jan. 22-25, 1935.

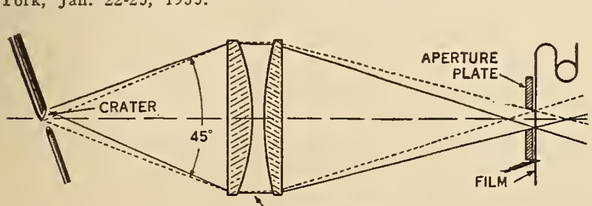


FIG. 2. Diagram of old type low-intensity D. C. lamp

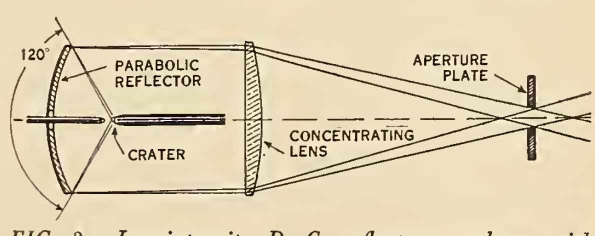


FIG. 3. Low-intensity D. C. reflector arc lamp with parabolic mirror

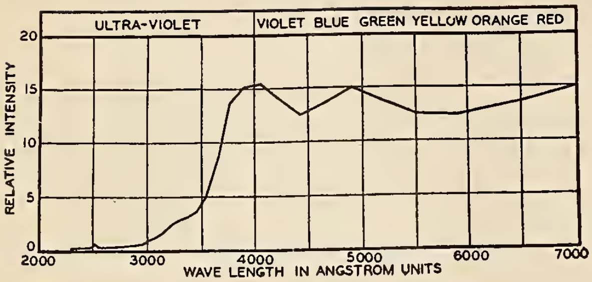


FIGURE 5

Spectral energy distribution from white-flame carbon arc

light pick-up from a solid angle of 45 deg. to one of approximately 100 deg. In this type of lamp, diagrammatically illustrated in Figs. 3 and 4, the carbon trim is horizontal with the crater of the positive carbon directly facing the mirror, thus exposing its full area to the optical system and at the same time simplifying the problem of the automatic control.

At arc currents of 28 to 42 amps. with positive carbons 12 or 13 mm. in diameter, the D. C. low-intensity reflector arc provides a sufficient intensity of screen illumination for theatres of considerable size. More lamps of this type than of any other are used in motion picture theatres today. They usually are operated from the standard voltage line through a transformer and rectifier or a motor generator set. The arc voltage is usually about 55 volts in this type of lamp.

The intrinsic brilliancy of the crater in the low-intensity neutral-cored carbon arc is limited by the vaporizing temperature of carbon, which is 4,126 deg. K. When this temperature has been reached, further increase in arc current will increase the crater area and the rate of carbon consumption, but cannot increase the intrinsic brilliancy of the crater any more than the boiling point of water in open air can be raised by applying more heat. Light from this arc approaches pure white in color, but retains a definite tinge of yellow.

The Flame Arc

Introduction of flame-supporting minerals in the cores of carbon electrodes transfers the principal source of light from the tips of the carbons, as in the neutral cored carbon arc, to the flame-like arc stream, and provides a much longer arc than that between neutral cored carbons. There is little difference in the appearance, behavior, or output of the flame arc on D. C. or A. C. The intrinsic brilliancy of the A. C. flame arc is relatively low, but, because of its size, it gives off a large volume of light and is a very efficient source of radiation. For like reason certain types of flame arcs are highly efficient sources of ultra-violet radiation.

An important characteristic of the flame arc is its flexibility, that is, the possibility of modifying the quality of the light by the choice of flame-supporting materials in the core. In Fig. 5 is shown the energy distribution for the white-flame carbon arc, the core of which contains minerals of the rare earth group, particularly cerium. The resultant light is bluish white, closely resembling daylight.

Carbons having polymetallic cores containing several metals including iron, nickel, and aluminum (known commercially as the "C" type) gives less visible light than the white-flame carbon, but much greater ultra-violet output. Strontium increases the red and infra-red emission from the arc with slightly lower ultra-violet output than that from the cerium cored carbon.

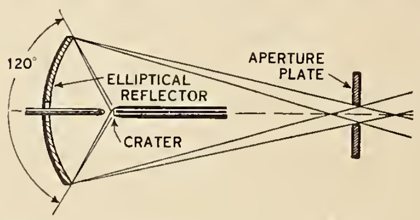


FIG. 4. *Low-intensity D. C. reflector arc lamp with elliptical mirror*

Wide Industrial Application

The white-flame carbon arc finds extensive application in photography, where its light is considered photographically equivalent to daylight. It is used more largely in photo-engraving than any other light source. In light therapy a similar carbon known as the "Sunshine" carbon is used extensively where it is desired to duplicate artificially the physiological effects of natural sunlight. The "C" type and the strontium-cored "E" type carbons likewise find extensive therapeutic use where emphasis on the ultra-violet or the infra-red bands of radiation is desired.

There is increasing use of the flame arc in industrial and photochemical processes such as accelerated testing of paints and dyes, the processing of certain materials, such as linoleum, patent leather, and tobacco, and the rapidly extending irradiation of milk for the purpose of increasing the vitamin *D* content.

The low-intensity A. C. white flame arc has found limited application in small motion picture theatres where D. C. is not available; but the superiority of the D. C. low-intensity reflector arc, operated from a suitable rectifier or motor generator set, has given it preference over the former type for projection purposes. Reference will be made later to a recent development that promises to modify greatly projection practice in theatres of small and intermediate sizes.

The various types of lamps using flame type carbons embrace a wide range of arc conditions. Arc currents from 6 to 100 amps. or more are used, and arc voltages from 25 to 60. The large lamps most popular in industrial applications and light therapy at the present time are operated at 60 amps. and 50 volts on A. C. and at 50 amps. and 60 volts on D. C.

D. C. High-Intensity Arc

Development of the high-intensity D. C. arc overcame the limitation of intrinsic brilliancy referred to in the discussion of the low-intensity arc. The positive electrodes of the D. C. high-intensity arc are operated at current densities much higher than those of the low-intensity arc —450 to 860 amps. per square inch (70 to 133 amps. per square centimeter) for the former in comparison with 120 to 200 amps. per square inch (18.5 to 31 amps. per square centimeter) for the latter.

Cored positive carbons 9 to 16 mm. in diameter without metallic coatings are operated with copper-coated negative carbons of smaller diameter at arc currents ranging from 60 to 190 amps., the arc voltage ranging from 45 to 90 volts.

In the condenser type high-intensity arc lamp as indicated in Fig. 6, the positive carbon is held in a horizontal position with its crater directly facing the condenser assembly. Since the current density in the carbon is very high and the high efficiency of this type of arc is dependent on the maintenance of a well-formed cup-like crater, the positive carbon is allowed to project but a short distance from the holder and is rotated

FIG. 6. *H. I. condenser type lamp*

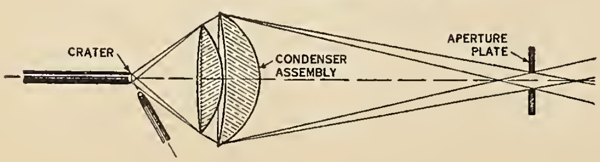
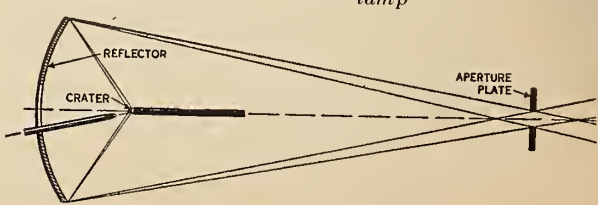


FIGURE 7 (*below*). *H. I. reflector type lamp*



continuously while the arc is burning. The negative carbon is set at an angle to the positive, usually 40 to 60 deg. below the horizontal.

The feeding mechanism is designed to advance both carbons as they are consumed and should be adjusted to feed the positive carbon forward at the same rate it is being burned, thus maintaining the crater at a fixed position in relation to the condenser and to the point of intersection with the axis of the negative carbon. The rate of feed of the negative carbon is also adjustable relative to that of the positive, and when properly adjusted maintains an arc of uniform length.

The reflecting principle of light concentration has been applied also to the high-intensity arc. In all high-intensity reflecting arc lamps the positive carbon is held in a horizontal position. The negative carbon also may be held horizontally or inclined to the positive, as shown in Fig. 7.

H. I. Light Source

Light from the high-intensity arc emanates from two distinct sources, the crater and the tail flame. The tail flame produces about 30 per cent of the total light from this type of arc, but is of little value for most applications since its size, shape, and position prevent its being focussed accurately. Therefore, a consideration of the characteristics of the high-intensity arc is concerned chiefly with the crater light from the positive carbon.

The whiteness and intrinsic brilliancy of this crater light exceeds that of incandescent carbon volatilized at atmospheric pressure. Evidently its source is something more than the solid tip of incandescent carbon, since its color and brilliancy indicate a temperature of about 5,500 deg. C. This intensified light can be considered as coming from a portion of the luminous gases of the flame material retained in the crater of the positive carbon by the force of the negative arc stream.

This explanation may not accord with physical facts but it aids the imagination in visualizing the reason for the remarkably high intrinsic brilliancy of the high-intensity carbon arc as compared with other artificial sources of illumination.

Maximum intrinsic brilliancy from the high-intensity arc is attained by adjusting the position of the negative carbon so that the negative arc stream compresses within the crater of the positive carbon a substantial portion of the brilliantly luminescent vapors emanating from that point. This produces a bluish-white light of very high candle power and much brighter than can possibly be obtained from incandescent carbon alone. A photograph of the D. C. high-intensity arc is reproduced in Fig. 8.

The energy distribution curve for a typical high-intensity carbon arc is shown in Fig. 9. On this is superposed the energy distribution curve for normal sunlight. Radiation from the arc as here measured is the radiation from the positive crater only, since in most applications of this type of arc the crater light is all that can be utilized. These curves show the striking similarity between this light source and natural sunlight through the entire range of the spectrum.

The candle power of the crater light directly in front of the arc is shown in Fig. 10. As would be expected, the

FIG. 8. Front and side views of H. I., D. C. arc

candle power increases with the current. When the same current is used with two different sized carbons of the same composition the smaller, that is, the one with the higher current concentration, gives the greater candle power.

The term "super high-intensity arc" has been given to the arc produced by special 16-mm. high-intensity carbons capable of carrying 195 to 200 amps. and producing 40 to 60 per cent higher candle power than the ordinary 16-mm. high-intensity carbon operated at 150 amps.

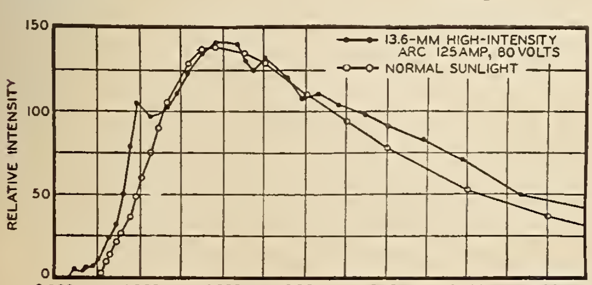


FIGURE 9

Spectral energy distribution from H. I., D. C. arc compared with that from normal sunlight

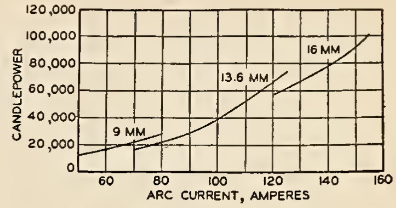


FIG. 10. Candlepower of crater light from H. I. arc for carbons of 3 different sizes

Motion picture projection in the larger theatres is the principal field of application for the high-intensity arc. There are many other applications, however, including theatre spotlights, motion picture studio sun arcs and rotary spots, army and navy searchlights, searchlights used for spectacular illumination, airport landing lights, and the famous Lindbergh beacon at Chicago.

THE smallest D. C. high-intensity arc with rotating positive carbon in general use is the so-called "Hi-Lo" lamp which uses a 9-mm. positive carbon operating at 60 to 65 amps. and 45 to 50 volts. A rather large interval exists between the screen illumination available from this lamp and that practicable with the low-intensity reflector arc used in the majority of small theatres.

There is also a marked difference in the color of light from these two types of arcs. The low-intensity arc gives a yellowish-white light, whereas the high-intensity arc gives a snow-white light generally considered more desirable for the projection of motion pictures. To bridge this gap and provide for the small theatre screen illumination of high-intensity quality and brilliancy, a metal-coated carbon of small diameter has been developed to operate at an intermediate current. The carbons for this small high-intensity arc have been so designed that the positive carbon does not need to be rotated and the negative can be coaxial with the positive. The carbons are protected from oxidation and their electrical resistance reduced by the metal coating, making it practicable to hold the carbon at any convenient distance from the arc. Arc current and voltage ranges for the standard size trims are shown in Table I. (see page following).

A. C., H. I. Arc

Operation of a D. C. arc of any type from an A. C. power circuit requires the use of a motor generator set or a transformer and rectifier. The development of an A. C. high-intensity carbon arc permits operation through a suitable transformer directly from the A. C. power line, thus eliminating all rotating intermediate apparatus as well as the heavy power loss in ballast resistance. This provides a very efficient source of projection light.

The A. C. high-intensity arc, together

Table I—Arc Conditions for Direct-Current High-Intensity Arc With Nonrotating Positive Carbon

Carbon Diameter, mm		Arc Current, Amperes	Arc Voltage	Current Density in Positive Carbon	
Postive	Negative			Amp per Sq In.	Amp per Sq Cm
6	5	35–40	28–35	800–910	124–141
7	6	45–50	29–36	755–840	117–130
8	7	60–65	30–37	770–835	119–129

Table II—Arc Conditions for Alternating-Current High-Intensity Arc

Carbon Diameter, mm	Arc Current, Amperes	Arc Voltage	Current Density	
			Amp per Sq In.	Amp per Sq Cm
6	40–45	18–24	910–1,025	141–159
7	60–65	23–26	1,005–1,090	156–169
8	75–80	24–29	960–1,025	149–159

with the D. C. high-intensity arc with non-rotating positive carbon, promise to supersede to a very large extent the D. C low-intensity reflector arc which at present is used in approximately 60 per cent of the motion picture theatres in the United States. The A. C. high-intensity arc is essentially a development from the ordinary flame arc obtained by increasing the current and reducing the voltage usually used with the ordinary flame arc, the intrinsic brilliancy of which is too low to be suitable for projection.

Light emitted by the white flame arc at currents up to 30 or 35 amps. increases directly as the voltage, but as the square of the current. The rate of increase of light with increased current decreases for currents of more than 30 to 35 amps. until at very large currents the rate of light increase becomes equal to the rate of current increase. By increasing the current but decreasing the arc length and voltage, the arc becomes steadier and the sources of light are concentrated into smaller volume near the electrode tips.

The A. C. high-intensity arc does not have the same crater formation as the D. C. high-intensity arc with rotated positive carbon, but the light has the brilliant snow-white quality characteristic of all high-intensity arcs. The appearance of this arc is shown by the photograph reproduced in Fig. 11.

Lamps designed for operation with A. C. high-intensity carbons are of the reflector type. Both carbons are of the same diameter and are burned in a horizontal position without rotation. Metal coating provides high electrical conductivity and permits support of the carbons

FIG. 11. A. C. high-intensity arc

at a distance from the arc. Arc currents and voltages for most satisfactory operation are given in Table II.

Although practically all of the light projected onto the screen is picked up from the carbon facing the reflector and this carbon is of negative polarity during alternate half cycles, there is no noticeable flicker in the screen illumination. This is because the light is of almost equal intensity during both positive and negative half cycles. In this respect the A. C. high-intensity arc differs materially from the A. C. low-intensity arc, and resembles the arc from rectified alternating current as may be seen from the oscillograms reproduced in Figs. 12 and 13.

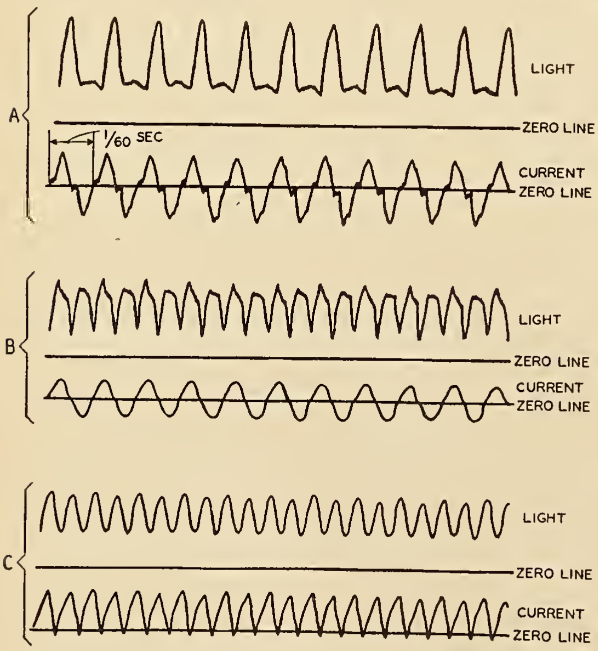
It is apparent from Fig. 12 that the screen illumination from the low-intensity arc during the negative half-cycle is less than half the peak reached during the positive half cycle, while the high-intensity arc shows very little difference between positive and negative half-cycles. Figure 13 indicates the flicker that results from the harmonic between the shutter speed and the circuit frequency with the low-intensity arc and the absence of a pronounced harmonic with the high-intensity arc.

A valuable feature of this arc and likewise of the D. C. high-intensity arc with non-rotating positive carbon is that the brilliant screen illumination made available to small theatres permits a level of general illumination that provides immediate comfortable vision to those entering the theatre. This is of decided advantage from the standpoint of safety as well as that of attracting patronage, and has heretofore been available only to the large theatres using powerful D. C. high-intensity projection lamps or to those "neighborhood" theatres small enough for the D. C. low-intensity arcs to provide a corresponding level of illumination.

At present, application of the A. C. high-intensity arc is confined to motion picture projection, but its possibilities are not limited to this use and it undoubtedly will find other fields of application.

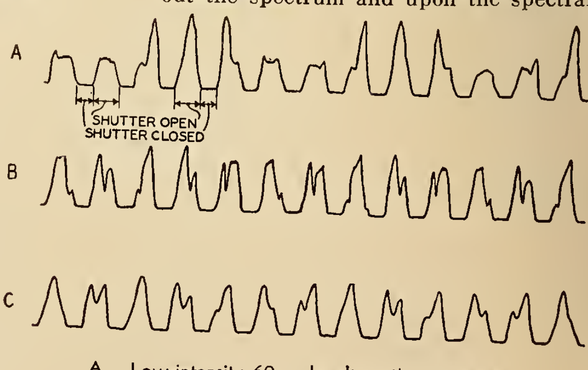
New Studio Carbon

The effectiveness of a light source in photography is dependent upon the distribution of its radiant energy throughout the spectrum and upon the spectral



A. Low-intensity 60-cycle alternating-current arc
B. High-intensity 60-cycle alternating-current arc
C. Low-intensity rectified-current arc

FIG. 12 (left). Oscillograms of arc current and instantaneous light on the screen without shutter running



A. Low-intensity 60-cycle alternating-current arc
B. High-intensity 60-cycle alternating-current arc
C. Low-intensity rectified-current arc

FIG. 13. Oscillograms of instantaneous light on the screen with 2-blade shutter, running at 1440 rpm (film speed of 90 f.p.m.)

sensitivity of the photographic emulsion. The plain carbon arc with only 17 per cent of its radiant energy in the visible and photographically effective ultra-violet range of the spectrum was satisfactory for the emulsions of an earlier day which were most sensitive to the blue, violet, and ultra-violet rays.

Early panchromatic emulsions, while extending the range of sensitivity to all visible colors, were still low in sensitivity to yellow, orange, and red. A special type of flame carbon strong in orange and red emission was developed to meet the demands of that period for an efficient light source giving equal photographic effect for all colors.

The development of present day supersensitive panchromatic emulsions, having much greater sensitivity to orange and red than the early types, calls for a light source of almost equal strength in all color bands; in fact, the color sensitivity of these emulsions is almost perfectly balanced to the radiant energy distribution of normal daylight.

An improved white flame photographic carbon recently has been developed to match the sensitivity of these latest photographic emulsions, thus giving the motion picture studios the advantages of speed and coolness which characterizes the use of the carbon arc in photography. More than 40 per cent of the radiation from this arc is photographically effective. This new electrode is a metal-coated carbon 8 mm. in diameter with a core composed of rare earth chemicals of the cerium group.

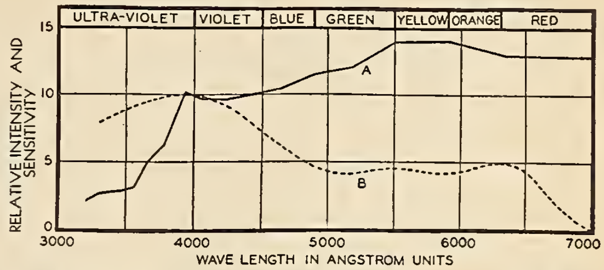
Special lamps developed for use with this carbon in the studio operate silently with continuous and uniform feeding of the carbons. These lamps overcome the objections to noisy and jumpy operation which were raised against the old types of arc lamps when sound was introduced into motion picture productions.

The new studio carbon arc is operated on D. C. at 35 to 40 amps. with about 37½ volts across the arc. At this current density, 450 to 510 amps. per square inch (70 to 79 amps. per square centimeter) and with the relatively short arc length employed, the arc departs from normal characteristics of the regular white flame arc and takes on many of the characteristics of the high-intensity arc; however, the crater formation in the positive carbon, while distinct, is not deep. The brilliant gas ball at the tip of the positive carbon consequently has a highly effective lateral emission.

This arc at 40 amps. and 37½ volts gives about 9.330 candle power in the horizontal direction. A twin arc (2 arcs

FIGURE 14

Spectral energy distribution of 40-amp. studio-carbon arc (A) and color sensitivity of supersensitive panchromatic motion picture film (B)



in series) without reflector gives approximately 200,000 lumens at this current and arc voltage compared with 158,000 lumens for the regular white flame arc using 13-mm. carbons under the same conditions. On a 115-volt circuit this represents an efficiency of 43.5 lumens per watt as compared with 34.4 lumens per watt from the ordinary white flame twin arc.

Radiant energy of this new carbon in the visual part of the spectrum is considerably greater than that of earlier types of flame carbons and shows a peak in that region where supersensitive films are least sensitive (Fig. 14).

This new carbon with the improved silent lamps designed for its use is restoring the popularity of the carbon arc in motion picture studios for black and white photography and has proved very efficient in the latest color process.

Intrinsic Brilliancy

In many applications such as searchlights, spotlights, and motion picture projectors, it is essential that a powerful light be obtained from a source of small dimensions. In this respect the carbon arc is unsurpassed. The intrinsic brilliancy, that is, the candle power per square millimeter, for several types of arcs is given in Table III. For comparison, the intrinsic brilliancy of other light sources is included in the data presented.

The carbon arc provides the basis for a ceaseless program of research. Steady improvements are being made in electrode manufacture as well as in lamp design. Longer electrode life, steadier operation, and higher electrical efficiency are being attained. New fields of application are being disclosed. Better adaptation to the many uses in which the arc now is applied is being achieved.

The high efficiency of the carbon arc as a source of visible and ultra-violet radiation, the flexible and uniform quality of radiation it provides, and its comparatively extremely high intrinsic brilliancy, give the carbon arc a prominent and increasingly important place in the broad field of illumination.

New Mirror Guard

Designed to overcome the troubles resulting from pitting by the new Suprex carbons, as well as to cut costs through the use of a relatively inexpensive guard for the mirror, there has been introduced by the Theatre Supply Company of New York a new product known as Mir-O-Guard.

Mir-O-Guards are made in various sizes to accommodate every type of reflector. They are made with fine optical glass, and each Mir-O-Guard is of the same identical curvature as the mirror which it is intended to protect. Exhaustive tests made under actual operating conditions over an extended period of time, and with various sizes of reflectors, proved that the resultant light loss is less than 1%.

Effect Large Saving

Sponsors of the Mir-O-Guard base their sales campaign on sharply reduced costs with no loss in efficiency. the thought being that the purchase for use two or three times a year of Mir-O-Guards, which cost from $3.95 to $4.95 each depending upon the size, is much more economical than would be the purchase at least twice a year of new reflectors costing from $15 to $25 each.

The installation of a Mir-O-Guard before the reflector requires only a minute, with two tension springs to be set. Distribution of these guards is now being arranged by Theatre Supply Co., 235 Fourth Ave., New York City.

MALOY HOME ROBBED

Five gunmen invaded the Chicago home of Thomas E. Maloy, business representative of Local 110, bound Mrs. Maloy and two other members of the household, and made off with $50,000 in cash and about $12,000 worth of jewelry, according to press reports from Chicago.

Maloy was reported in Canada at the time of the robbery.

Table III—Intrinsic Brilliancies of Light Sources

Light Source	Candle Power per Square Millimeter	Source of Data
Magnetite arc stream	6.2	W. R. Mott, National Carbon Co. Lab.
Flame arc stream	8.0	
900-watt special-tungsten-filament clear gas-filled bulb	26.6	International Critical Tables
Positive crater of cored, d-c low-intensity carbon arc	155– 175	*Journal*, Soc. of Motion Picture Engrs.
Crater of a-c high-intensity carbon arc	280	
Positive crater of nonrotating d-c high-intensity carbon arc	380	
Positive crater of rotating d-c high-intensity carbon arc	400– 800	
Positive crater of d-c "super high intensity" carbon arc	1,000–1,200	National Carbon Co. Lab.
Sun at zenith	920– 950	

STEP-BY-STEP ANALYSIS OF COMMON AMPLIFIER TYPES

Aaron Nadell

V. RCA Photophone Type PA 83

FIGURE 1 shows a complete sound system from photo-electric cells to loud-speakers. Modern sound equipment is more compactly made, more closely knit than were earlier models, and it is not always easy to isolate the new amplifiers and analyze them separately. In Figure 1 both the power and the speech circuits of the amplifier are intimately linked with the loud-speaker on one side and the photo-cells on the other.

Among those portions of Figure I that have no direct connection with the amplifier are the two exciter lamp supply rectifiers in the lower left-hand corner of the drawing. Since the two are identical, we need trace only one of them.

The function of these rectifiers is to convert line a. c. to filtered d. c. for the use of the exciter lamps. At the upper right of this circuit is rheostat R-19, through which the line voltage is reduced and the exciter supply regulated. Next to the left is the diamond-shaped "stack" rectifier, the action of which is by now familiar to readers who have followed previous articles of this series. To the left of the rectifier are the two reactance coils, L-5 and L-6, and the condenser, C-11, making up the filter that removes the ripple from the rectified d. c. To the left of L-5 is the a. c. line switch, and to the left of this is the exciting lamp.

We may trace this circuit briefly, assuming the upper input wire to be positive. Then, from positive to negative, the circuit is through the a. c. switch, through R-19, down left through the upper left-hand stack of the rectifier, up and left through the filter coils, left through the exciter, down right to the right-hand corner of the diamond, down left through the lower right-hand stack, and back to the a. c. line.

Monitor Speaker Amplifier

When the lower a. c. wire becomes positive, the circuit runs up left through the lower left stack; then around through the d. c. circuit precisely as before, up left through the upper left-hand stack, and back to the power line through R-19 and the a. c. switch.

This disposes of the two circuits in the lower left-hand corner of Fig. 1.

The lower *right-hand* corner of Fig. 1 contains a separate one-stage amplifier, complete with its own power supply. It will be very helpful to trace this circuit before considering the larger system amplifier. One reason is that, while most of the circuits of the diagram are essentially similar to others considered earlier in this series, the method of drawing them is to some degree new.

For example, consider the filaments in the two 245 tubes in the monitor amplifier. They are equipped with arrowheads instead of connecting wires carrying heating current. About an inch from the lower of the 245 tubes, diagonally downward and right, is shown the center-tapped secondary winding of a power transformer, with its outer leads terminating in arrowheads that are labelled "To UX 245 FIL". This, plainly, is the source of the filament power. The connecting wires are omitted to make the drawing simpler. That is only one of the several novelties in this drawing.

The a. c. supply to this one-stage, push-pull amplifier is shown at the extreme lower right. To the left of this is a power transformer, T-8, with three secondaries. The upmost secondary, mentioned in the preceding paragraph, is the one that supplies the filaments of the 245 amplifying tubes. The lowest secondary lights the filament of the 280 full-wave rectifying tube. The center secondary supplies plate power to the rectifier, and through it to the 245's.

The circuit of the 280 and the center-tapped plate secondary of the transformer is similar to the full-wave rectifiers we have studied in other amplifier drawings. Most of those used two tubes for full-wave rectification; in this case the same purpose is served equally well by a single tube equipped with two separate and insulated plates.

Only one rectifier plate is active at a time—that plate, of course, which happens to be positive at the moment. With respect to that plate (whichever it is), the center-tap of the transformer secondary is always negative. The wire that leads outward from the center-tap of the secondary is always the negative wire of the d. c. output of the rectifier. The filament of the rectifying tube is also negative with respect to the positive plate, but not so much so; and the wire leading outward from the filament is always the d. c. positive.

Let us trace this circuit, beginning at the negative end, or center-tap, of the plate secondary. From that tap upward, right, and up again to the 1820-ohm coil, L-3. Through this coil and down through the biasing resistor R-26 to the mid-tap of the filament supply secondary. Thence through the arrowheads to the filaments of the amplifying tubes. Through the vacuum to the plates of those tubes and through the plate transformer primary to its center-tap; thence downward to the filament of the 280 rectifier tube. Through this filament and the vacuum to the positive plate, and thus to the positive end of the power transformer secondary.

In this circuit L-3, which is also the field winding of the monitor speaker, performs the work of a filter choke-coil to smooth the output of the rectifier. This particular choke happens to be in the negative d. c. lead, instead of in the positive lead, as is more usual. The condensers C-15 and C-16 bridge across to the positive line from either side of this choke-coil and complete the filter arrangement.

The reader who remembers the choke-and-condenser filter combinations of earlier drawings of this series, will note that the draftsman has used a different pattern in this instance; but tracing the wires will show him at once that the electrical arrangements are the same.

The grid bias of this amplifier is secured through the voltage-drop across the 810-ohm resistor, R-26. The positive side of this resistor connects to the filaments through the center-tap of the filament supply transformer. The negative side may be traced to the grid upward, left, and again upward to the junction of the two grid resistors.

At the extreme left of the monitor amplifier is a 500-ohm potentiometer, R-23. Two leads from this run upward to the secondary of the output transformer of the system amplifier. The sliding contact can be set to tap any desired proportion of the voltage drop developed across the 500-ohm resistor, and therefore serves as a monitor volume control. A portion of the voltage-drop across R-23 is thus connected in parallel to the prim-

ary winding of T-6, the speech input transformer of the monitor speaker amplifier.

The a. c. voltage generated in the secondary of T-6 causes current to flow through the grid resistors R-24 and R-25. The voltage-drop developed across each of these resistors is connected across the grid and filament of the corresponding tube. The connection to the filament is from the junction between the resistors downward, right and down to the top of R-26, and through R-26 to the center-tap of the filament winding of the transformer.

The a. c. component of the plate circuit may be traced from the plates of the tubes through the plate transformer primary mid-tap and downward about an inch to the right-hand side of condenser C-15; through that condenser and upward, right and then down to the top of R-26; through R-26 to the filament secondary and thus back to the filaments of the tubes.

The output circuit is, of course, from the plate transformer secondary through L-4, the 3.8-ohm voice coil of the loud speaker. So much for the monitor amplifier. We are now ready for its big brother.

The System Amplifier

The "power pack" portion of the main amplifier is shown at the bottom *center* of the drawing. Line a. c. is supplied to the primary of a power transformer, T-5, that has four secondaries. Just to the left of the longest, or plate secondary, are two 280-type tubes, tubes 7 and 8, in a full-wave rectifying circuit. Their filaments are lighted by the topmost secondary of the power transformer.

The two bottom secondaries of T-5 are the ones that light the filaments of the amplifying tubes in the system amplifier. The lower of the two supplies the '56 and '57 tube heaters; the upper of the two lights the four filaments of the 245 power stage.

These four tubes are shown directly above the two 280's. The '56 tube, a heater-type triode, is about an inch to the left of them; the '57, a heater-type pentode, is an inch again to the left of that. All these filaments terminate in arrowheads, indicating connection to the appropriate winding of the power transformer. The photo-electric cells, of course, have no filaments to be heated; their cathodes emit electrons under impact of light.

The two 280 tubes shown just to the left of the power transformer provide plate current for the system amplifier and its two photo-electric cells. A 280 tube is designed to serve as a full-wave rectifier all by itself, and we see one so wired in the power supply of the small monitor amplifier that we analyzed a moment ago. But in the case of this larger power pack one 280 tube isn't enough, so two are used. Each tube serves as a simple half-wave rectifier, because its two plates are connected together, and the two together constitute a full-wave rectifying circuit.

This circuit is in every way identical with the full-wave rectifying arrangements in amplifiers discussed earlier in this series. If the reader does not at once recognize it as such, that is merely due to the trifling difference of two connected plates inside of each tube, instead of a single plate. As a matter of fact, a 280 tube also has two filaments, one inside each plate, but the drawing does not show them.

The two filaments act electrically as one filament. Two plates connected together act electrically as one plate.

The plate of the upper 280 (the two connected plates being one), is wired to the upper end of the plate secondary of the power transformer. The plate of the lower 280 tube is wired to the lower end of that secondary. The center-tap connection of that secondary constitutes the negative lead of the rectifier's d. c. output. We may trace that lead downward, left to the right-hand side of choke-coil L-8, and thence upward to the place where the power is used.

The positive line of the d. c. output leaves the filament supply secondary (the top-most secondary), and branches two ways. One branch runs upward to supply the four 245 tubes. The other runs leftward through choke-coil L-7 to supply the '56 and '57 tube, and the photo-electric cells. We can trace this rectifier circuit in detail, beginning with the branch that supplies the 245's.

The Rectifier Circuit

Starting at the negative terminal, which is the center-tap of the plate secondary, the circuit runs downward to the right-hand end of L-8, thence upward two inches, right two inches and upward an inch to the right-hand end of L-1, which is both a filter choke and a speaker field coil. Through this coil downward a half inch

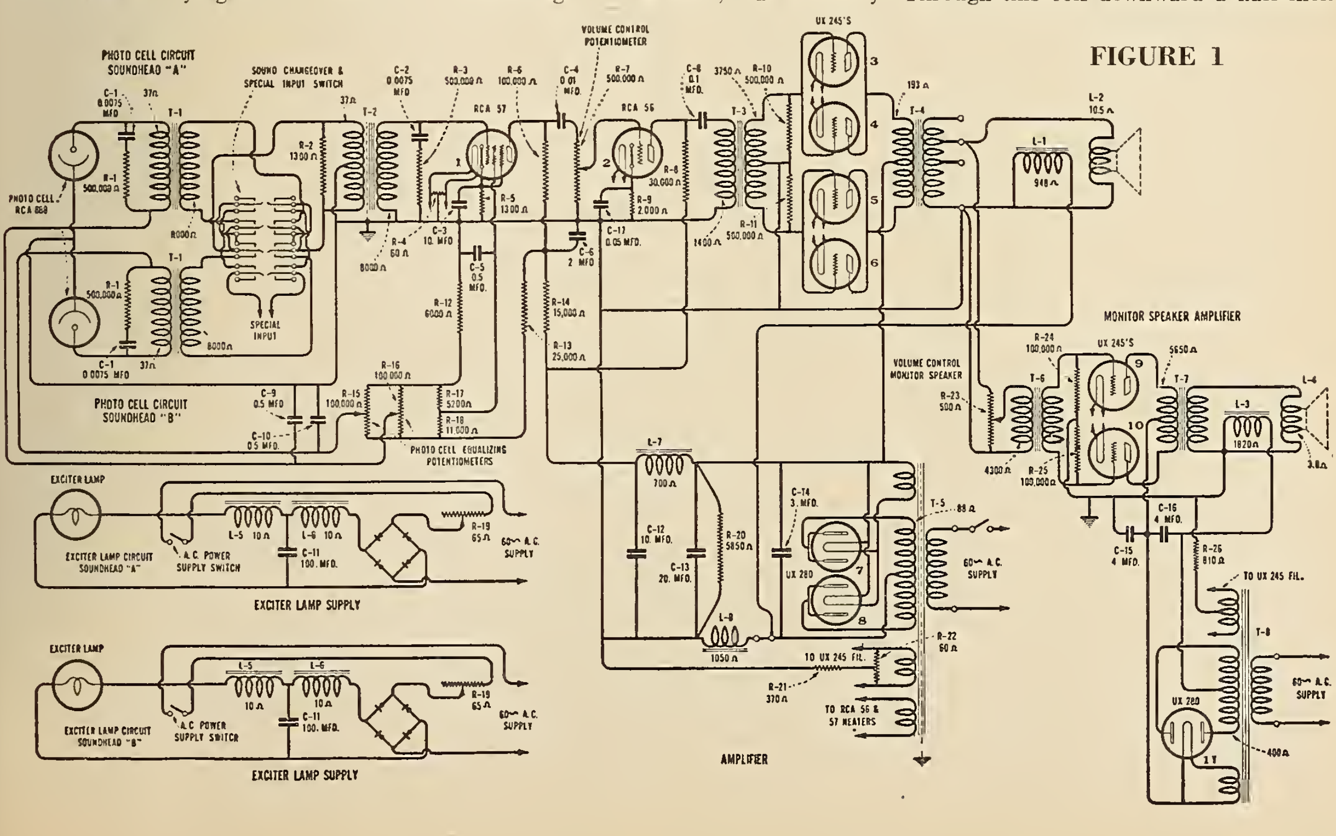


FIGURE 1

and left a half-inch to the terminal from which two separate wires run downward. Through the left-hand wire down about an inch, left about three inches, down three inches, and right two inches to bias resistor R-21; through this and through R-22 to the filaments of the 245 tubes. Thence across the vacuum to the plates.

From the plates to the center-tap of the plate transformer primary, and from this downward to the filaments of the rectifying tubes. Through the vacuum to whichever rectifying plate is positive at the moment, and thus to the positive end of the plate secondary, completing the circuit.

Now let us return to the negative side of that circuit, to the center-tap of the rectifier plate secondary winding, and thence down and leftward to the right-hand side of the filter coil L-8. From this point we have traced the circuit upward, left and upward to the right-hand side of coil L-1. But there is a parallel branch directly leftward through L-8. The left-hand side of L-8 is wired directly to the left-hand side of L-1, a fact easily traced. Therefore, L-1 and L-8 constitute two filter chokes in parallel. When *two* speakers are used, their field windings are connected in parallel, and L-8 is removed from the circuit by opening the link connection at its right-hand side.

Above and to the right of L-8 is the filter condenser C-14; above and to the left the filter condensers C-13 and C-12. Directly above is the bleeder resistor R-20; and further above and to the left the reactance coil L-7 provides additional filtering for that branch of the plate supply that runs to the smaller tubes and to the photo-cells.

The plate supply of the '56 traces from negative to positive as follows: from the center-tap of the rectifier plate secondary downward, leftward through L-8, and then up about three inches to the lower side of C-17. (A parallel line branches, as we have just seen, from the right-hand side of L-8 and runs upward, right, upward, through L-1, down, left, down, left three inches, and up to the lower end of condenser C-17. From that point right a bit, and up through the grid bias resistor R-9 to the cathode of the '56; through the vacuum to the plate; down through the 30,000-ohm resistor and about an inch and a half further, left an inch, down an inch, and right through L-7 to the rectifier filaments.

The plate supply of the '57 follows the above route as far as the lower side of C-17. Thence left about an inch to the lower end of R-5, and upward to the cathode of the '57. Across the vacuum to the plate, straight down through R-6 and R-14, and then right through L-7. Within the vacuum the screen grid supply branches off, and the return to positive runs from the screen grid (the central of the three grids), down and left to the upper end of R-18; down through R-18 and right and upward through R-13 to contact with the positive d. c. line at the upper end of R-14.

For the plate supply to the photo-cells we must follow the negative d. c. line from the center-tap of the plate secondary of the power transformer leftward through L-8 and up to the lower end of C-17, and then continue leftward from that point about two inches until just past the ground connection underneath the core of transformer T-2; then down left, past the filter condensers C-9 and C-10, left another two inches, upward an inch, and right a half-inch to the common cathode wire. Then through the vacuum to the cathode of either cell.

From the anode of the upper cell right, down through the primary of T-1, left an inch, down two inches, right three inches, and upward to the sliding contact of the voltage control potentiometer, R-16. Downward through that resistor, right, upward through R-13 and downward through R-14 to L-7 and the positive side of the line.

The anode of the lower photo-cell is similarly wired through the primary of the lower transformer to the sliding contact of voltage control potentiometer R-15, which, of course, has the same return to positive.

Grid Bias Circuits

The upper ends of these potentiometers are wired directly, as we have traced, to the cathodes of the cells, and the sliding contacts connect to the anodes; therefore, if the sliders are pushed all the way, the cell is short-circuited. As they are moved downward, a greater and greater percentage of the voltage drop through the potentiometers is connected between anode and cathode.

The grids of this amplifier are "self-biased" by means of the voltage-drop across three resistors. Returning to the 245 filament secondary of the power transformer, we see just to the right of that secondary R-21, and remember that this resistor is in series with the plate supply of the four 245 tubes.

If the reader cares to refer back a few paragraphs and retrace that circuit, he will find that the left-hand side of R-21 is the negative side. From this left-hand side a wire runs left, upward, right about an inch, and up an inch to the grids of the 245 tubes. The right-hand, or positive side of resistor R-21, connects of course, to the tube filaments.

An inch to the left of the 245's is the '56 tube. The grid bias of this tube is obtained by means of the drop across R-9, the resistor shown just below the cathode. The plate circuit runs from the cathode, through R-9, to the negative side of the plate supply. From the lower end of R-9 there is a connection leftward about a half inch to the lower end of R-7, and thence up and through the sliding contact to the grid of the tube.

The '57, about an inch left of the '56, receives its bias in the same way. Resistor R-5, just below the cathode, provides the necessary voltage-drop. The upper, or positive, side of that resistor ties to the cathode; and the lower, or negative, end traces left about one inch to the lower end of the secondary of input transformer T-2, thence upward through that winding and right to the control grid (the left-hand grid), of the pentode.

(The right-hand grid of the pentode is, of course, the suppressor grid, wired direct to the cathode.)

The Speech Circuits

The first speech circuit of this system amplifier originates in the vacuum of the photo-electric cell, where fluctuations in the light received impose an a. c. component, or fluctuation, upon the photo-cell d. c. The speech circuit may be traced from either cathode down and leftward to the filter condensers C-9 and C-10. Thence downward, through the condensers, left, up and right to the primaries of the two T-1 input transformers, which are the photo-cell coupling transformers mounted on the projector. Through these primaries and back to the anode of either cell.

Each primary is by-passed by resistor R-1 in series with condenser C-1. This arrangement improves the low-frequency response of the system, since it by-passes more of the high- than of the low-frequencies. Of course, only those frequencies that flow in the primary of T-1 are coupled to the secondary of that transformer, and so pass on to the amplifier.

The secondaries of both photo-cell transformers run to the fader, a "sound changeover and special input switch." By means of this switch the output of either photo-cell transformer or of a third "special" input source, can be connected directly across the 1,300-ohm input resistor R-2, shown above the fader and to the right of it.

The second speech circuit may be considered as that which originates in the output winding of either T-1 transformer, and flows through the fader switch to R-2 and to the input winding of T-2.

Transformer Shielding

T-2 is an input transformer that is exceptionally well shielded, because of the high gain of the pentode tube that it supplies. The transformer is surrounded by a thick and heavy iron case (Fig. 2). Figure 1 shows that the core is grounded and the center-tap of the primary is also grounded. The object of these elaborate precautions is to protect the amplifier against hum or other disturbances.

The next speech circuit originates in

the secondary winding of this input transformer and is connected across the cathode and control grid of the pentode. C-2 and R-3 constitute another by-pass that favors low-frequency response. Irregularities in the screen grid current are returned to the cathode through C-5 and C-3 and do not extend backward to the power source.

Fluctuations in the plate current result in an alternating voltage-drop across R-6. Thus one speech current may be taken as originating in the vacuum of the pentode and may be traced through R-6, through C-6, and thus back to the cathode. The alternating voltage-drop thus created results in a proportionate flow of a. c. through the parallel circuit of R-7.

This is the simple resistance-coupling arrangement we have often seen before. R-7 serves as the volume control, since any desired portion of the voltage-drop across it is tapped to the grid and cathode leads of the '56 tube. The circuit is through the sliding contact to the grid of the tube, and, on the other side, from the bottom of R-7 through C-17 to the cathode of the '56. C-17 helps the high-frequency response, since the lower frequencies must travel around it through the resistance of R-9.

The d. c. component of the plate circuit of the '56 is supplied upward through R-8 (as previously traced); but the a. c. component flows from the plate through C-8, through the primary of T-3, then left and back to the cathode through C-17—some of the lower frequencies returning to the cathode through R-9.

The next speech circuit is that generated in the secondary of R-3 and flowing through resistors R-10 and R-11. The voltage drop developed across these resistors is applied to the grids and filaments of the push-pull tubes. The fact that there are four tubes in this particular push-pull arrangement means only that the manufacturer chose to use two small tubes in parallel on each side of the push-pull circuit, instead of one large tube on each side, as in the push-pull circuits previously analyzed.

The present arrangement is not unusual; a number of manufacturers use it.

The upper end of R-10 connects to the grids of the two upper 245's, and the lower end of R-10 may be traced down an inch, left an inch, down three inches and right two inches to the filament supply secondary of the power transformer, and thence to the 245 filaments. R-11 may be traced in the same way, of course, with respect to the lower two 245's.

The speech circuit originating in the vacuum of the 245's may be traced from the plates to the plate transformer (T-4) primary; from the mid-point of this primary down about three inches, left about two inches and to the right-hand side of L-7, then down about an inch to filter condenser C-13. Then downward through C-13, left an inch, around the bend downward and back right to the filament supply winding of the power transformer; thence back to the filaments of the 245's.

The condenser, C-13, thus allows the a. c. component of the 245 plate circuit to return to the filament without passing through the rectifier and the plate secondary of the power transformer.

The speech output circuit arises in the secondary of T-4 and flows chiefly through the speaker voice coil L-2, but there is a parallel branch through the 500-ohm potentiometer R-23 which supplies the monitor amplifier.

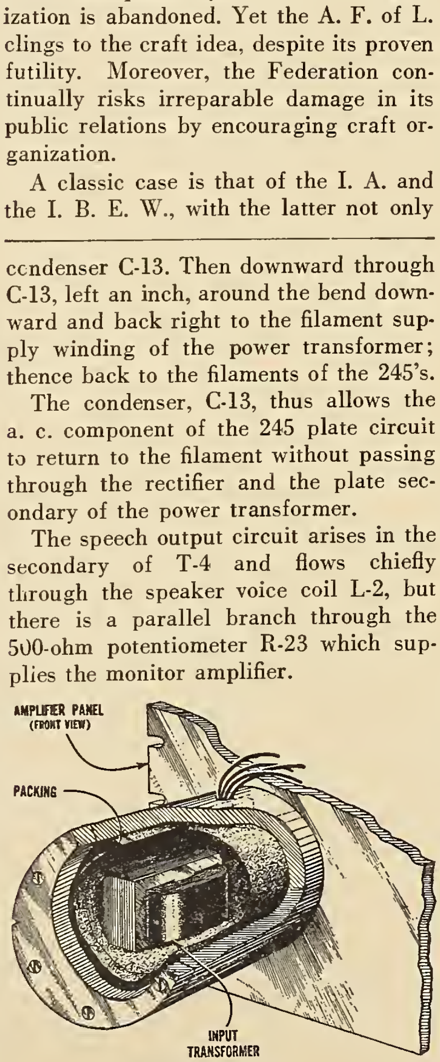


Figure 2

CRAFT VS. INDUSTRY UNIONS

FROM the American Federation of Labor convention in San Francisco recently was flashed the news that the issue of craft vs. industrial unions had been "settled" by a victory for adherents of the latter type organization. Such is not the case. This jurisdictional question, in which theatrical workers have a vital interest, remains to plague the labor movement.

The industrial unionism approved by the A. F. of L. convention applies *only to mass production industries*, such as that of automobiles. Strangely enough, it is the mass production industries which least need assistance in the form of "permission" to organize along industrial lines, because the failure to extend such approval would have resulted in the speedy exit of the automobile workers from A. F. of L. ranks. Undeniably, the action taken by the convention was purely in self-defense.

It is common knowledge that there can be no real progress in the movement until the antiquated system of craft organization is abandoned. Yet the A. F. of L. clings to the craft idea, despite its proven futility. Moreover, the Federation continually risks irreparable damage in its public relations by encouraging craft organization.

A classic case is that of the I. A. and the I. B. E. W., with the latter not only taking over the studio work—but doing so while I. A. workers were on strike! The stench arising from this bit of piracy endures to this day—but the A. F. of L. did nothing about it. Another typical case was the partitioning of the Brewery Workers among several of the more powerful unions, including the Teamsters and the Engineers. Thus, the Teamsters might have members in one hundred different trades—a situation hardly conducive to effective organization or efficient administration.

The A. F. of L. has its roots in the craft union idea, dating back to the days when it could organize only along such lines. Even five years ago the A. F. of L. leaders never dreamed of organizing entire industries (such as automobiles), which is precisely the situation now confronting them. Meanwhile the Federation governing Council continued to be packed with rabid craft unionists whose outlook on the problem likely will never change.

Once one of the stronger crafts intrudes upon the smaller union's domain, it is practically impossible to move the former out. No matter which course is pursued, either craft will have to take a beating—and it is a certainty that neither will take it gracefully. Here lies the rub. It is all very well for a given craft convention to request action on a jurisdictional encroachment, and then to hand the hot poker to some one man or to a group of men. Experience has proven that the time to yell is when something happens, otherwise—well . . . . . .

That the craft union idea will endure is greatly to be doubted. How long it will last nobody can foretell. But that the recent action of the A. F. of L. convention with respect to the mass production industries is of any significance to scores of small union organizations is emphatically not so. That is, not yet.

Maybe the year 1934 has seen the industrial union man gain a first advantage that will insure a steady yearly gain. Surely the Federation itself, in every fibre of its being, ardently wishes that it had originally pursued the industry union plan. But such changes come slowly, and nowhere as slowly as in the ranks of organized labor whether the action of the San Francisco holds any promise for the various crafts now beset by jurisdictional trouble is difficult to prophesy. But it is conceivable that it will serve at least as an effective bar to any further encroachments by the "big fellow" unions.

For the future well-being of the A. F. of L. it is fervently to be hoped that this is just what it does mean.—J. J. F.

RECENT TECHNICAL ADVANCES IN PRODUCTION

E. A. Wolcott

RKO STUDIOS, HOLLYWOOD, CALIFORNIA

Many improvements have been made in recent years in the equipment used in producing motion pictures. Not the least of these advances is process projection, which finds a steadily increasing application. The accompanying paper, originally presented before the S. M. P. E., refers to this and other new aids to production work.

SOUND engineers have realized for a long time that theatre audiences are becoming increasingly critical of the quality of the sound in a motion picture. As a result, new refinements in sound recording and reproducing equipment have been found necessary; in particular, recording and reproducing equipment for extending the frequency range.

The application of the new sound recording equipment in making motion pictures demands considerable precision in operating the various devices, controls, *etc.*, particularly in connection with the manipulation and placement of the velocity microphones furnished with one system of extended frequency-range equipment.

During the filming of a picture, the sound crew consists of the following members:

(1) The first sound man, usually termed the "mixer" or "recordist".

(2) The second sound man, or "stage man".

(3) The third sound man, or "assistant".

(4) The fourth sound man, also known as "stage electrician".

The mixer is in charge of the sound crew, and is directly responsible for the quality and volume of the recorded sound. It is his duty also to see that harmonious relations exist at all times between the sound crew and the other members of the company producing the picture.

The stage man operates the boom to which the microphone is attached. The work calls for considerable skill, particularly in making moving or dolly shots, and whenever the actors have occasion to move about the stage during dialog sequences. In some of the large studios in Hollywood he acts also as contact man between the recordist and the director of the picture.

The assistant has charge of the film recording machine, which is usually located in a permanent booth some distance from the mixing booth. His duties consist in loading the recorders, keeping a complete log or report of the operations of the sound crew throughout the day, and also aiding the recordist to keep a careful check on the operation of the anti-ground-noise device.

The fourth sound man, or stage electrician, operates a starting panel on which are placed suitable controls for starting the cameras and recorders and placing the synchronizing marks upon the edges of the sound and picture negatives by means of an electrical marking system. He also aids the stage man in connecting the cables and suspending the microphones in the various requisite positions on the set.

The Velocity Microphone

Extended frequency-range sound recording equipment is particularly suitable for the velocity microphone, although the standard condenser type may be used. The directional properties of velocity microphones are very advantageous, particularly when it becomes necessary to pick up and record a dialog spoken in the midst of a large group of persons, such as in a mob scene. Another advantage is the possibility of achieving what is known as "close-up quality" during the filming of a scene, using two or more cameras, one camera photographing a fairly long shot and the other a medium shot.

Usually when the picture is edited, the medium shot is used for the greater part of the scene, and it is necessary to match the perspective of the sound to the closer camera as much as possible. In a recent feature picture, this characteristic was very helpful, inasmuch as practically all the scenes consisted of medium and long shots, very few of them being close-ups.

When using the velocity microphone, it is important that some means be provided to rotate it, so that it may always be directed toward the source of the sound. The device for rotating the condenser microphones, as used in the past in practically all the major studios in Hollywood, is quite satisfactory for rotating the velocity microphones. However, due to the greater sensitivity of the velocity microphone to transmitted shocks, or to vibrations generated in the boom that carries it, a new kind of suspension was required.

A suspension developed by the RCA Victor Company consists of an inverted metal yoke to which the microphone unit is attached by means of a 4-point rubber suspension. It possesses excellent qualities as a mechanical filter, and is quite

Some Choice Additions to the Nomenclature

Culled from a single recent issue of a British technical paper, and submitted by George A. Bishop, Jr., of Fall River, Mass., are the following delectable departures from the approved term, "projection room":

1. Bio Box
2. Operating Box
3. Machinery Box
4. Bioscope Chamber
5. Projection Chamber

Bad as are the foregoing, none of them matches the contribution of those worthies engaged at the State Lake Theatre, Chicago. These nice boys had their names printed under the heading, "kino booth".

That's Chicago for you.

Hunts Ducks With Projector

STRANGE things happen in projection rooms—such as warming soup in a lamphouse and cleaning clothes—but no more novel story anent projection has ever been written than the appended news dispatch wired from Beaver Flats, Nebraska, to newspapers throughout America:

The duck season opened in the Calamus Valley Tuesday and Peterson, not having a shotgun, took a moving picture projector from his theatre Tuesday evening and went out to the bad lands west of town.

There he pointed the machine at the white wall of a marl cliff and began running an advertising reel of some fishing lake scenes as soon as he heard the ducks coming down his way.

The scenes—displayed upon the cliff walls—of sylvan lakes with birds soaring above and fish leaping from the waters, proved most entrancing to the oncoming flocks flying through the darkness and they crashed head on against the cliff in attempting to alight upon the phantom waters.

Then Peterson gathered up several hundred ducks and came back to town, where he was promptly arrested. Peterson's attorney contends he has committed no offense as the game laws do not mention moving picture machines as lethal weapons, and also that the law against tolling wild game by artificial device to be slaughtered does not apply, as the ducks killed themselves by flying against the cliff.

There seems little doubt but that Peterson is some jinks as a projectionist, if not as a hunter—but one wonders just what he used for power supply.

satisfactory for all practical purposes.

When using the velocity microphone in motion picture work, it is very important that the operator of the microphone boom be very adept in manipulating it. He must remember the actors' cues so that the microphone may always be aimed at the person speaking. If the source of sound is outside the beam or area of sensitive coverage, a considerable loss of volume will occur, although no great change of quality will be noticed.

Recently, the directional properties of velocity microphones have been utilized to control the brilliance, or the reverberant energy "pick-up," in a room in which orchestral recordings are made. For such purpose, two microphones are used; one is aimed at the orchestra in the usual manner, and the other is so placed as to pick up the reverberant energy. The output of each microphone is fed into separate positions on the mixing panel, and the gain of each adjusted to afford the proper "life" or brilliance to the recording.

Occasionally, the directional characteristic of the velocity microphones becomes a slight handicap, particularly in a close-up shot, when the director wishes to include the lines of an actor not in the scene being photographed. Such a difficulty is solved by using an additional microphone, so placed as to provide the proper volume and quality for the off-stage voice.

Visual Amplitude Indicator

Another recent development is the device known as the visual amplitude indicator, which makes use of a series of small neon glow lamps arranged on a panel attached to the mixing panel and immediately above it. The voltages necessary to operate the lamps are obtained from an additional amplifier which utilizes a small part of the output signal of the standard recording amplifier. Sixteen glow lamps are suitably arranged to indicate a total volume range of 53 decibels. A gain control is incorporated in the additional amplifier in order that the amplitude indication of the instrument may be adjusted to correspond to the amplitude of the sound track.

The uses of the amplitude indicator are quite varied. It is particularly adaptable to motion picture sound recording and broadcasting. It is also very useful for restricting the volume range of large symphony orchestras within certain required limits The calibration of the instrument was checked several times a day over a period of several weeks of motion picture production, and the maximum deviation from the original calibration was not more than $\pm\frac{1}{2}$ db.

Another important factor in recent years that has contributed considerably to the improvement in sound recording, is the use of sets made of cloth. Cloth of the proper color, conforming to the specifications of the art director is stretched over wooden frames, care being taken to brace the frames securely when they are placed in position, particularly those sections adjacent to doorways in the scene. As the cloth used for the purpose is of a fairly thin texture, it is necessary to cover the back of each frame with black cloth, so as to prevent any light from shining through.

This type of set construction is particularly satisfactory for scenes of small rooms, in which hard walls would impart a very disagreeable booming quality to the recording.

It is still common practice, however, to use hard walls for very large sets, such as ballrooms, churches, theatres, *etc.*,

HIGH FIDELITY FOR 31 RKO's

Arrangements have been completed for the immediate replacement of the sound equipment in thirty-one RKO houses located in fifteen principal cities throughout the country with the latest type of Photophone High Fidelity sound apparatus. Replacement work will start at once and is expected to be completed in all of the theatres within ninety days.

which is quite all right from a sound standpoint, as a fairly brilliant quality is necessary in order to produce the proper illusion. This is particularly true in recording music, in which case the brilliance resulting from the reverberation often improves the final result.

Process Projection Gains

Process projection, recently introduced in making motion pictures, has made it very simple to record many scenes which heretofore were practically impossible to record. For instance, dialog scenes in flying airplanes, speed boats, racing automobiles, and many others, can now be photographed on the sound stage, where the recording conditions are ideal. The real sound effects can be added later, thus lending a degree of reality to the scene heretofore unattainable.

Examples of what can be accomplished with the process are illustrated in several recent feature productions.*

Process projection is comparatively simple; the essential requirements are a projector, a camera, and a suitable translucent screen. The camera and projector must be equipped with interlocking motors so that their respective shutters operate synchronously. A translucent screen developed for the purpose at the RKO Studios was found to be exceptionally well suited for this type of work.

Recently in New York, the new silent Debrie cameras were used with extended frequency-range sound recording equipment in the regular production of motion pictures. The camera is self-contained, no silencing blimp being necessary. The camera is practically silent, and it is possible to record normal dialog with the camera at a distance of only three feet from the microphone, without introducing perceptible camera noise in the recording. It is light in weight, and is equipped with a base or tripod capable of adjustment to various camera heights.

The base is also equipped with suitable mechanism so that it may be used for moving or dolly shots, and is adaptable to the standard Mole-Richardson camera dolly used in many of the major studios.

*Flying Down to Rio and King Kong.

Notes

Film exchange workers in Minneapolis have been organized with the approval of the A. F. of L. into a union which is believed to be the first of its kind. The group will seek a charter from the State Federation of Labor.

Hearing on the supplementary code submitted by the Independent Theatre Supply Dealers Assoc. will be held on Nov. 2 in the Ambassador Hotel, Washington, D. C.

Nat Golden, chief of the Motion Picture Section of the U. S. Dept. of Commerce and a member of Cleveland Local 160, has received his commission as a Kentucky Colonel from Gov. Ruby Laf-

fon. Golden received his commission while attending the recent encampment of the Veterans of Foreign Wars at Louisville, Ky., as department commander of the District of Columbia.

Golden recently was admitted to the practice of law in the District of Columbia.

An appeal to the Code Authority has been taken on the decision of the Detroit local grievance board to restrain the exhibition of free film shows within a radius of 25 miles from any established theatre. Michigan exhibitors have suffered greatly from the competition of itinerant film shows.

Francois Giordano, president of the film projectionists in Marseilles, France, was killed recently when he stuck to his post after fire has broken out. To escape suffocation by the fumes in the projection room, Giordano thrust his fist through a glass window. He cut an artery in his wrist and died from loss of blood.

West Coast cameramen affiliated with the I. A. introduced a resolution at the recent A. F. of L. convention which asked that the American Society of Cinematographers be compeled to terminate its existence as a company union. All major productions now give a credit line to the A. S. C. after the name of the cameraman on the production.

KREUZER'S NEW RCA POST

Barton Kreuzer, long associated with Photophone engineering and service, has been appointed technical consultant to RCA Victor High Fidelity recording licensees. He will assist RCA recording licensees by keeping them abreast of the new developments and improvements in sound recording constantly being made in the RCA laboratories.

NEW CONDENSER CATALOG

The correct condenser or resistor for practically any standard need can be found in the 1935 edition of the Aerovox General Catalog just issued. Electrolytic, paper, oil-filled, mica, tubular, bakelite case and other types of condensers are listed, as well as wire-wound vitreous enamel, carbon and other types of resistors.

A copy may be obtained from the Aerovox Corp., Brooklyn, N. Y.

1000th W. E. WIDE RANGE

The 1,000th Western Electric Wide Range installation has been completed in the Atlas Theatre, Seattle Wash. It beat the completion of the 1,001st Wide Range installation in the Howell Theatre, Platka, Florida, by 45 minutes.

NO I. A. BOARD MEETING

No meeting of the I. A. General Executive Board was held, as is usual, at the recent A. F. of L. Convention in San Francisco. Attending the sessions were President George Browne and the elected delegates, Thomas E. Maloy (Chicago) and T. V. Green (Newark, N. J.). Vice-president Billingsley resides in S. F., therefore was on the ground.

President Browne held that insufficient business failed to justify the expense of convening the Board.

Rosenblatt Defends N.R.A. in A. F. of L. Speech

FOR the second successive year Sol. A. Rosenblatt was the only N. R. A. representative invited to address the American Federation of Labor Convention. Excerpts from the speech by Rosenblatt, who is in charge of all amusement codes, at the recent A. F. of L. meeting are appended hereto:

Last October when addressing you in Washington, I said "The National Recovery Administration is the greatest experiment in pracical idealism ever conceived in the minds of human beings." Nothing that has transpired since then has caused me to change my mind on that thought.

Great as the gains are that we have made since last October—and no one certainly will deny that they have been very great indeed in making business fair in the 90% of industry now under codes and in finding work for millions of our people—we are still trying to

achieve complete recovery. The jungle has been cleared. There is a long job yet to be done.

But we have gone far enough along the way for all of us to know that complete recovery can only be achieved when Capital and Labor—the working man and the capitalist—jointly assume the burdens of common industrial endeavor and jointly enjoy the rewards and opportunities of their common enterprise. That way lies recovery—and not otherwise . . .

Flexibility of Codes

With respect to the labor provisions of any code, even though such provisions constitute advances for the maintenance and raising of the labor standards present in the industry affected, nevertheless under the ever present concept of flexibility, if such code provisions do not at once accomplish the end for which they are intended, appropriate changes can and will be promptly and effectively made . . .

The question of labor's rightful place in a civilized state is as ancient as civilization. The effort today is to bring about united action of management and labor . . . To my surprise, amazement and horror, in the past year I found situations where, before a Code existed, labor was receiving as low as 85c a week, and $2.25 a week was considered an average salary . . .

"It is utterly impossible to continue in business unless the wages are cut," I have been told by one so-called "small fellow" who came into my own office. He said that the N. R. A. was oppressing him; was keeping him out of business; was going to close his factory . . .

When pressed as to precisely what he wanted, he asked the N. R. A. give him the right to cut his employees down from $11.00 per week, the code minimum, to an average of $5.90 a week, and I said "No" then, and I say "No" now. If that is oppression of the small man, then it will have to be called just that.

My sympathy remains with the small fellow who works for that small man —the little fellow whose week's wages will barely buy a few pounds of oatmeal; a bag of coal; and nothing more luxurious than a 39c shirt for his Sunday best. That's the small fellow I am worried about.

Codes are fair competition . . . but don't let it be competition based upon debasement of labor; don't let it be competition to see who can make toil more hopeless and unbearable for the wage-earner.

If you have any fault to find with N. R. A., I will defend your right to

(*Continued on next page*)

ANOTHER N. Y. C. UNION?

Formation of still another projectionists' union in New York City is reported imminent. The new unit would be the fourth, the three existing unions being Local 306, I. A. wing; Empire State Union, and Allied Union, the latter allegedly a company union financed by exhibitors.

It is reported that I. A. President Browne intends shortly to split Local Union 306 into two sections, one for Manhattan and the Bronx, with the other taking Brookyn, Queens and Richmond.

find fault and to criticize. That is your privilege and your duty; but bear in mind that there are hundreds of thousands of people in this country who, in spite of ineffective enforcement, have benefitted to a tremendous extent because of this very N. R. A.

A. F. of L.'s Responsibility

I am not talking so much of the large centers of population because organized labor can pretty much take care of itself. I am talking about the millions of people outside of your direct control who do not belong to your organization, but to whom you owe just as much a duty as you do to your own members, which surely you must realize. The code administration, frankly, has not been perfect, nor perhaps has the enforcement been as strict and effective as it should . . .

The duty of capital and labor is plain and apparent. Realizing the problem, theirs must be the willing hands, constructive and helpful, loyally supporting with their efforts and energy the leadership which seeks a sane and balanced relationship between labor and capital.

The N. R. A. is determined to go forward in its great work. It cannot be swayed or deterred from its purpose by innuendoes or aspersions cast upon the honesty and sincerity of its motives . . . It cannot be threatened or coerced by that type of self-seeking, self-styled leaders of industry, or of labor, whose fundamental purpose it is, principally from political considerations, to harass and destroy rather than to put their shoulders to the wheel in an effort to help and cooperate . . .

I ask that labor, in Convention here assembled, recognize that the path of industrial progress lies forward and not in retracing our steps.

In conclusion, I submit to you that the codes enacted into law under the N. I. R. A. are entitled to the sympathetic and constructive cooperation of our people, in order that the results sought to be obtained for the benefit of labor, industry, and the consumer in the first instance may be achieved . . .

THE INDUSTRY RE-DISCOVERS MR. FOX AND TRI-ERGON

(*Continued from page* 8)

the world, and particularly in America, is easily the dirtiest business extant, with the root of the trouble being the accumulation by any one person or organization of vast numbers of patents.

Victory in patent litigation is not a question of right or wrong; it is peculiarly one of who has the biggest bankroll. The patent racketeering that has gone on in both the radio and sound picture fields the past ten years is one of the dirtiest pages in the history of American industrial development.

The system is simple: Mr. A, possessor of numerous patents having what is technically known as "nuisance value" and also a large bankroll, sues Mr. B, a small manufacturer of, let us say, chairs, who has a small bankroll. Mr. A first sues Mr. B on, say, the chair seat and loses; then he repeats the performance on, say, the arms and again loses; again he sues Mr. B on the back and, still once more, on the legs. Having lost all these suits, let us say, Mr. A comes right back and again sues Mr. B on the method of joining either the back or the legs to the other sections of the chair.

Somewhere along this route Mr. B. goes broke and is unable to defend himself. Mr. A, out of the goodness of

his heart, might "settle" by paying an insignificant sum for the "purchase" of the Mr. B's business; or the latter might get nothing. In any event he has lost his business, is likely to have been broken mentally and physically and is turned out of a business into which may have gone years of sweating Why? Because he was wrong? No; only because he was a victim of patent racketeering at its worst.

Somewhere among the reams of copy written about this Tri-Ergon matter was the comment that there really is nothing in the Fox legal victory to worry about, since the business may be expected to go on as usual. This sage observation is best dismissed with the statement that William Fox fervently hopes so—otherwise, he will not get a sou.

Situation is Serious

Yes, the business will go on, of course, but this Tri-Ergon matter will do it no good. Already in serious difficulties through bankruptcies, falling receipts and moral crusades, the motion picture industry can ill afford to have visited upon it at this time any such trouble as is represented by the Tri-Ergon legal actions.

And make no mistake about it, this Tri-Ergon situation is serious—deadly serious. Maybe some sections of this industry are mildly annoyed that the newspapers gave the Fox victory such a big play; yet it is this writer's opinion that they didn't overdo the story. Every bit of space accorded Tri-Ergon in the public prints was merited by the importance of the story, the gravity of the situation precipitated thereby.

Certainly the motion picture industry will continue operating—Tri-Ergon or no Tri-Ergon, and certainly there are numbered among the technical forces of RCA, of Erpi and of the leading producers and laboratories, men with sufficient ingenuity and technical knowledge and skill to supply the industry with substitutes for those elements of equipment and those processes the right to which is claimed by Tri-Ergon.

Certainly the substitutes previously cited are particularly attractive and very likely will pan out all right. But at the very best the industry will be seriously inconvenienced—at the very best—and the possibilities inherent in any situation short of the very best are of such gravity as to be damned serious for this business of motion pictures.

International PROJECTIONIST

Electrics Extend Servicing Work

S. M. P. E. PROJECTION COMMITTEE SUPREX REPORT . . . ANALYSIS OF AMPLIFIERS . . . A YEAR OF THE CODE . . . RECTIFIER TYPES

December 1934
Vol. 7 No. 6

A magazine devoted to better visual and sound reproduction

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With Which is Combined PROJECTION ENGINEERING

Edited by James J. Finn

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MONTHLY CHAT

WE direct the attention of the projection field to the story appearing in this issue relative to the projected all-inclusive theatre servicing plan which sound companies are expected to introduce shortly. Nobody is privileged to tell the sound people what they may or may not do; but projectionists, supply dealers and manufacturers owe it to themselves to carefully evaluate the effect of any such plan on their future welfare.

We have always considered the sound serviceman as a potential threat to the security of projectionists, this theme being the topic of numerous editorials herein. Maybe constructive action looking toward the protection of Labor's interest in this field has been too long neglected; maybe it is not yet too late to do this job. Anyhow, careful consideration of the aforementioned story should start the thought mechanism to churning.

NO other story that has appeared herein provoked the enthusiastic response induced by "The Suprex Carbon Arc" which appeared last month. The number and tenor of the hundreds of comments thereon which reached this office are indicative of the continuing interest of projectionists in things technical as well as a tribute to the intelligence of the craft.

The A. C. arc failed to win general acceptance in this field not because of any mere collection of words appearing herein but because of the ability of projectionists generally to recognize an inferior product, despite a terrific ballyhoo accorded it. We congratulate the craft.

SOUND reproducing systems of the near future will be of platinum with gold trimmings—if one is to believe the writers attached to the non-technical press who attempt to explain the "innovations" designed to walk around the Tri-Ergon patents. Summed up, it appears that the flywheel will have to be replaced.

FOR the year 1935 we have to look forward to only the following: vastly improved color pictures, more hooey concerning the NRA; higher amperages for Suprex arcs; new rectifiers; 4,673 additional forecasts of "television just around the corner"; requiem services for the A. C. arc; bigger and better free radio shows; double reels; a couple new editions of projection tomes; lower wages and increased taxes; Congress; a hot summer; more "flesh" acts; more efficient projection optics—and better projection, we hope.

OUR New Year greetings to one and all, without benefit of holly, or Old English type or two-color printing: the best of everything that life has to offer during 1935.
(And may God bless the NRA.)

● A. C. High Intensity projection gives the smaller theatres the patronage drawing power of *immediate comfortable vision* and *snow white screen illumination.*

D. C. High Intensity projection in large downtown theatres has proved that patrons appreciate comfortable vision on entering the theatre and clear, snow white projection on the screen. The box office value of these features is now available to theatres of moderate size at little added cost of operation.

One New Patron Per Day Pays For It

NATIONAL PROJECTOR CARBONS

NRA CODE

Give your patrons the best

NATIONAL CARBON COMPANY, INC., Cleveland, Ohio
CARBON SALES DIVISION
Unit of Union Carbon UCC and Carbide Corporation
SALES OFFICES: NEW YORK, PITTSBURGH, CHICAGO, SAN FRANCISCO

INTERNATIONAL PROJECTIONIST

VOLUME VII NUMBER 6

DECEMBER 1934

Electrics Plan All-Inclusive Theatre Servicing

Projection Room and Stage Included in General Plan Along With Equipment Sales, Installation and Maintenance

By *James J. Finn*

NATIONWIDE servicing of theatres "from the roof to the cellar," to include the projection room, the stage, lighting and heating, plumbing—in fact, all general maintenance work, and probably the sale and handling of equipment—is planned by at least one, and probably both, of the major sound equipment companies, according to reliable information received by INTERNATIONAL PROJECTIONIST.

Such a plan is fraught with great significance to, if not actual danger to the welfare of, projectionists, stagehands, supply dealers and, possibly, manufacturers. The importance of the first two groups seems certain to be minimized almost to the vanishing point, through the operation of such an all-inclusive plan, while the supply dealers can look forward to, at best, drastically reduced sales.

The status of manufacturers of motion picture equipment is uncertain at this time, although the experience of independent sound equipment manufacturers to date is interesting in this respect. Both Erpi and RCA are understood to be feverishly at work in an effort to be first in the field with such a service, the former having had a long lead in the way of preparations, while the latter is reported to have embraced the same idea in "self-defense."

New Contracts Will Follow R. & R. Plan

The contracts to be written for this new service are expected to follow the same pattern as the Erpi R. and R. (repair and replacement) contract which provides for a flat weekly payment covering both sound servicing and parts, the latter consisting mostly of tubes, exciter lamps, photo cells, etc.

The first indication that such a plan was being formulated was given in these columns in a report of the Spring, 1934, Meeting of the S.M.P.E., the papers program for which included a paper entitled, "Technical Theatre

Operation", by H. M. Wilcox and L. W. Conrow of the Erpi organization. In commenting on this paper[1] this writer said:

"But by far the most interesting paper . . . and one which induced the least comment when it was presented, was 'Technical Aspects of Theatre Operation,' by Messrs. Wilcox and Conrow of Electrical Research Products.

"Expecting a paper on . . . sound reproducing systems, the audience was greatly surprised to hear discussed the projector, lamphouse, screen, seating, carpeting, flooring, lighting, plumbing and heating—in fact, the entire range of theatre management and operation was covered.

"Erpi to date has specialized in sound equipment . . . and almost every auditor passed over the extensive scope of the paper with the thought that the writer was rambling. Near its close, however, the paper clearly disclosed Erpi's idea of rendering service on all these items at a 'reasonable' cost—a point which seemed to miss its goal insofar as 98% of the listeners were concerned.

" . . . the paper appeared to this writer to be the first gun in a campaign by Erpi to offer a complete engineering service to theatres, with the sound equipment slated to be only one item in an overall supply and maintenance plan."

Thus the program that now bids fair to be realized. But there is evidence other than the aforementioned paper, to which we shall return shortly, linking the sound equipment companies with an all-inclusive theatre servicing and maintenance plan. Particularly interesting is the establishment some months ago by one of the companies of an elaborate testing laboratory housing every conceivable type of projection and stage equipment, extensive use of which has been made by different groups of seven or eight field men who have been routed through the premises weekly.

In addition, extensive surveys have been made of many theatres throughout the country, the data accruing from which has been sent to New York headquarters for collating along with a mass of projection and stage information, both old and new, which has been assembled. The projection reports of the S. M. P. E. have been eagerly sought after, even prior to their official release, and implements used for various projection equipment adjustments have been in demand.

Secrecy Cloaks Preparations

Strenuous efforts to cloak these activities with the strictest secrecy having proved unavailing, the sound companies. when queried on the meaning of all this activity and not inconsiderable expense, reply that it means nothing except that they are "making certain tests," or "just playing around," and that there is absolutely "nothing to it" as far as any general servicing plan is concerned.

The new plan obviously stems out of the servicing of sound picture equipment during the last few years, the income from which is known to have fallen off sharply within the past year or so. Confronted with a sharp decrease in operating revenue, and taking advantage of the very limited technical knowledge of the average exhibitor, the sound companies evidently see in the plan a means for keeping intact their servicing organizations and at the same time bolstering their incomes.

Returning to the S. M. P. E. paper previously mentioned, it should be noted that the paper is divided into four distinct sections, as follows:

Projection
Sound
Light, Power and Heat
Building Maintenance

Heretofore the so-called electrics have confined themselves entirely to sound reproduction, and their sudden interest in other theatre departments buttresses the belief that their policy to date will be subjected to drastic revision—and expansion.

The content of the paper in question lends color to this belief. A few striking phrases culled at random therefrom are appended hereto. (The italics in every case are ours.) In the introduction:

"There is an old adage, 'If you want a thing done right, do it yourself'; but in this highly specialized age this should probably read, 'If you want a thing done right, hire someone who knows how.'"

The foregoing is innocent enough in itself but highly significant when coupled with certain statements in the section headed "Projection." One learns therein that Erpi has "recently made a study of screen illumination in a large number of theatres," and that "not in one single case was it found that the screen illumination from the two projection machines was the same, and variations between machines was found to be as high as 50 to 100 per cent."

The paper then proceeds to discuss picture size, screen light intensity and its useful application as compared with current costs. Jump, weave, graininess and other film imperfections are discussed. Mention is also made of screen life, the projector intermittent and the cost of release prints in terms of film mutilation. All this work is obviously quite a labor of love on the part of Erpi—unless, of course, they mean to make practical application of the results therefrom.

Concerning Personnel

Winding up the "Projection" section is this pointed reference:

"The theatre *personnel* assigned to the *operation* of the *projection equipment* should be *trained men;* definite routines should be established for maintenance of the equipment, and *certain standards established* against which actual performance can be *checked from time to time.*"

Projectionists will undoubtedly relish this commentary on their work.

The paper then proceeds to the "Sound" section, which has been the province of the electrics ever since the bars were let down on the admittance of outsiders to the projection room, thus these comments merit no special attention at this time.

Subsequent divisions of the paper deal with "Light, Power and Heat" and "Building Maintenance," both of which represent new interests for the electrics, that is, where theatres are concerned. Both these divisions are studded with subtle references as to not only *what* should be done but *how* and *by whom.*

But the real kick of the paper is reserved for the closing paragraphs embedded in which one comes across the following statements bereft of any pretense to subtlety:

"As we consider each of the many problems which a theatre manager must deal with, *it is quite evident* that to handle the more involved technical problems of maintenance efficiently he must look for assistance and advice *of an engineer or a group of engineers.*"

That rather touchy passage having been safely negotiated, the paper then proceeds to hammer home the real reason for its preparation. Witness:

"The question is, *how much will maintenance of this character cost?* It will cost something, of course, but in *the long run* the savings in *efficient handling* of maintenance will result in a reduction of *direct operating expenses,* longer life of equipment, and satisfied patrons, and will make the net expenditure a very small percentage of the cost of operation."

And there you have it. It might be

[1] Int. Proj., April, 1934, Page 15.

THOSE 'BACKWARD' EUROPEANS

The Union of Yugoslav Cinemas has requested all owners of motion picture theatres to handle their films more carefully than they are now doing, reports Reed Paige Clark, American Consul at Belgrade. He further states that the Union has demanded that projection and sound apparatus be kept in good repair so as not to damage foreign property and prejudice the next moving picture house at which the given picture will be shown.

The Union even goes so far as to suggest the closing of theatres where films are mishandled.

said, and quite correctly, that even the aforementioned paper is a very thin line upon which to hang so much clothes; to which the answer is that INTERNATIONAL PROJECTIONIST has gone to not a little trouble to dig into this matter. The results of this investigation prove beyond any reasonable doubt that not only is such a plan in work but that its announcement is only a few weeks away, if that long.

Naturally, the logical response to the foregoing is, what of it?

Without attempting to speak officially for either projectionists or stagehands, it can be said that these groups undoubtedly will resist with every weapon they can muster the fruition of any such general servicing plan. The tendency of such a service undeniably would be to minimize the importance of these workers.

Significance to Labor

The projectionist has been buffeted about enough to date, without having to stand the knocks which are almost certain to be visited upon him by the operation of any such servicing scheme If he is to be trampled upon a bit more, according to several impartial observers, then he may just as well throw up his hands and quit. Ditto for the stagehand, particularly those who are now engaged in maintenance work.

If, on the other hand, such a servicing plan will not operate to encroach further upon the projectionist's domain (something that was accomplished rather neatly by the sound equipment service man), and if it will help the projectionist to produce a better show through keeping his equipment up to snuff by obtaining parts and effecting needed repairs—then, *and only then,* the plan might be acceptable to Labor.

This angle is something for the sound companies sponsoring the plan to mull over. It can be said without fear of contradiction, however, that the assurance given on this point will have to be very much more definite than any mere jumble of sweet-sounding words.

On the face of the record, however, the sound companies might just as well put up their backs right now insofar as any wholehearted acceptance from the projection field is concerned. The projection field, mindful of 1928, is not likely to suffer any sudden mental lapse.

Unions Now Servicing

An interesting sidelight to this matter, and one not generally known, is the fact that not a few Local Unions of the International Alliance are today servicing sound equipments. This writer could name offhand at least ten Locals now engaged in this type of work, and doing a first-class job, too. This angle might prove of absorbing interest to the electrics.

The status of theatre supply dealers under the new order of things appears to be pretty well defined. It is inconceivable that the electrics, once launched upon the new program, will resist the impulse to buy, sell and install equipment direct. This would make the profit just that much larger and undoubtedly would enable establishment of a rock-bottom price on the "servicing".

Should this situation eventuate, the theatre supply dealers as we now know them could make arrangements to go into some such enterprise as the junk business, to set up in which they could use their existing stocks. And this is no attempt to inject humor herein, either.

The manufacturers are in a somewhat different classification. If the sound companies go along and patronize the usual sources of equipment supply, there might be no objection on the part of manufacturers. But the question is: Does the policy adopted by the sound companies from 1928 until now justify the belief that all manufacturers would receive equal consideration? Or is it a fact that the sound companies, having adopted a given equipment item, proceeded to execute a blanket contract for its use to the exclusion of all other makes?

Maybe the few independent sound equipment manufacturers who have had sales experience in the theatre field between 1928 and now could supply the answer to these pertinent questions.

And there you have it. Without attempting to predict the outcome of this matter, it is the safest bet in the world that the attempted introduction of this all-inclusive service plan will raise merry Hell in this industry and produce results of a character which probably will not be altogether to the fancy of either side of the argument.

WHAT OF THE SMALL THEATRES HAVING L. I. ARCS?

Eric W. Schumacher

NORIS CARBON COMPANY, INC.

MUCH has been written about projection with the modern A. C. and D. C. Lamps, and the high-low and high-intensity types have also come in for not a little attention. However, it seems that the enormous field of low-intensity projection has been neglected, or glossed over, and this is indeed a strange thing in view of the fact that more than 60 per cent of all lamp houses in use are of the low-intensity type.

The amount of light produced by the low-intensity carbon arc is remarkable considering the small load of amperage required; and the light intensity of these lamps could be improved greatly if more care was taken in their maintenance and operation.

Popular Sizes, Amperages

Considering first the smallest carbon combination for low-intensity arcs, the 10-mm. x 8" positive and 7 mm. x 8" negative, the customary load for this trim should not be more than 13 to 18 amps. This trim is usually found in small theatres having a seating capacity of from 200 to 350 seats and with a projection throw of from 50 to 60 feet. The amount of light produced by this trim is comparatively enormous.

The most popular low-intensity trim is the 12 mm. x 8" positive and 8 mm. x 8" negative, which is used in theatres having from 350 to 550 seats and a throw of from 65 to 75 feet. The required amperage is from 18 to 25. Next is the 13 mm. x 8" positive and 9 mm. x 8" negative combination which is used in theatres of from 500 to 700 seats having a throw of from 65 to 85 feet. The load for this trim is 23 to 28 amperes.

In cases which cannot be considered as normal, such as a theatre having 500 seats and a throw of 85 feet, or where still better light is desired because of an old-type screen, difficulties of obtaining a uniform current supply, etc., the manufacturers of projector carbons have created a "special" brand. These special brands are better known under such trade names as the Bio SA, the Sun-Arc SAS, the National SRA, and the Noris SCH.

These special combinations are intended to meet the demand for a low-intensity trim using higher amperages and giving correspondingly more light. The loads for the various special trims are:

10 mm. x 8" Pos. cored
7 mm. x 8" Neg. cored
18 *to* 23 *amperes*

12 mm. x 8" Pos. cored
8 mm. x 8" Neg. cored
25 *to* 32 *amperes*

13 mm. x 8" Pos. cored
9 mm. x 8" Neg. cored
30 *to* 35 *amperes*

Operating Precautions

Although low-intensity reflectors are the most widely used lamps, and thousands of projectionists are handling both lamps and carbons, there still are many operating faults to be corrected. The best possible results will be obtained if

(*Continued on page* 25)

TECHNICAL AND ECONOMIC ASPECTS OF THE SUPREX ARC

A Report by the Projection Practice Committee, S. M. P. E.

INADEQUATE screen illumination has long been a problem of major importance in the projection field generally. Satisfactory screen illumination has been confined mainly to the larger theatres, the smaller theatres being either unable or unwilling to make the expenditure necessary to improve the quality of screen light.

Exhibitors have recognized the need for more and better light on the screen; and they have recognized, too, the fact that the problem was more economic than technical. The situation, already serious, promised to become acute with the increasing use of color in motion pictures.

Happily, the solution of the problem appears to be at hand, in the form of a new type d-c. projection arc which not only materially improves screen illumination but also satisfies the economic urgencies of the situation. This arc, using the new copper-coated *Suprex* carbons, is the topic of this report, the importance of which to the exhibition field is emphasized by the Committee.

This article needs no introductory or explanatory statement. It speaks for itself—clearly, concisely, thoroughly and impartially. It avoids theory and treats only with facts. It is far and away the best of a long line of fine jobs done by the Projection Practice Committee of the S. M. P. E., and as such is a splendid tribute to the Committee, composed mainly of practical projection men, and to the Society, as well as to the craft generally.

Mere words would not suffice to properly evaluate the worth of this paper to the industry. It is proudly presented in these columns.—Editor.

Based on Extensive Tests

This report is based upon an extensive series of tests of the new arc made under actual operating conditions. Through the courtesy of various manufacturers there was made available to the Committee a group of motor-generators, both single- and three-phase rectifiers, and arc lamps of practically all the new types.

The Committee desired to obtain the answers to the following questions:

(1) What is the carbon consumption per hour for values of current from 40 to 50 amperes, using the 6- and 7-mm. combination; and from 50 to 65 amperes, using the 6.5- and 8-mm. combination?

(2) What is the ratio of burning of the positive and negative carbons at different current densities?

(3) What effect does the arc gap exert upon the burning rate of either carbon; and what arc gap affords the best results?

(4) Is there a difference in arc voltage with different sources of supply, such as rectifiers and generators?

(5) Is there any difference in the quality of the projected light when power is derived from either rectifiers or generators?

(6) What increase of light occurs with an increase of carbon current density?

(7) How do the various lamps now available compare as to light intensity, for a given current?

(8) What is the efficiency and power-factor of the several power sources used with the new lamps?

(9) What can be done to protect the reflector against pitting?

(10) What are the over-all advantages of this new type of light source?

(1) Tests were made to determine first the rate of carbon consumption for various current densities, the arc gap being maintained constant—that is, at from 5/16 to 11/32 inch; using as sources of current a polyphase rectifier, a single-phase rectifier, a motor-generator, and the regular d-c. power line.

Carbon Burning Rate

The tests (Fig. 1) indicated that the consumption of the 6-mm. negative carbon was constant for currents between 40 and 50 amperes, being 3¾ inches per hour or ⅝ inch for each ten minutes. The burning rate of the positive carbon, however, varied with the current. For 40 amperes, the rate was 6¾ inches per hour, or 1⅛ inches for each ten minutes; for 45 amperes, 10⅛ inches per hour, or 1-11/16 inches for each ten minutes; and for 50 amperes, 13½ inches per hour, or 2¼ inches for each ten minutes.

Similar tests were made using the 6.5- and 8-mm. carbon trim at currents from 50 to 65 amperes, with the following results:

For 50 to 57 amperes, the 6.5-mm. negative carbon burned at the rate of 3¾ inches per hour, or ⅝ inch for each ten minutes—which is identical to the burning rate of the 6-mm. negative at 40 to 50 amperes. However, at 65 amperes, the 6.5-mm. negative carbon burned at the rate of 4½ inches per hour, or ¾ inch for each ten minutes.

The consumption of the 8-mm. positive carbon (Fig. 2) at 50 amperes was 6 inches per hour, or 15/16 inch in ten minutes; at 55 amperes, 8¼ inches per

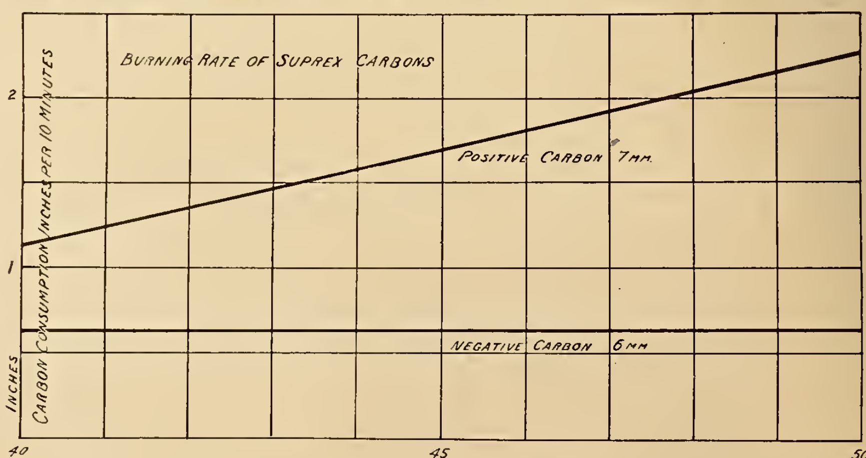


FIGURE 1

Burning Rate of Suprex carbons; 6-mm. negative and 7-mm. positive trim

hour, or 1⅜ inches in ten minutes; at 60 amperes, 10½ inches per hour, or 1¾ inches in ten minutes; and at 65 amperes, 13½ inches per hour, or 2¼ inches in ten minutes.

(2) The burning ratio between the positive and negative carbons of the 6- and 7-mm. trim at 40 amperes is 1.8 to 1; at 45 amperes, 2.7 to 1; and at 50 amperes, 3.6 to 1.

With the 6.5- and 8-mm. trim the burning ratio at 50 amperes is 1.6 to 1; at 55 amperes, 2.2 to 1; at 60 amperes, 2.6 to 1; and at 65 amperes, 3 to 1.

The tests definitely established that the burning time and the ratio of consumption of the positive and negative carbons do not change whether the arc current be supplied by a single-phase rectifier, a polyphase rectifier, or a motor-generator set, and that the design of the lamp also has no effect upon the aforementioned characteristics.

The rate of consumption of the positive carbon is greatly affected by the current density; whereas the burning rate of the 6-mm. negative carbon is affected little if any by the current density between the limits tested. However, the burning rate of the 6.5-mm. negative carbon varied slightly with the current density, particularly for currents greater than 55 amperes.

Although the operating limits of these carbon trims are generally understood to be 40 to 50 amperes for the 6- and 7-mm. trim, and 50 to 65 amperes for the 6.5- and 8-mm. trim, the tests conducted by the Committee established definitely that best results are achieved when the trims are operated within the upper limits of their rated capacities.

Correct Arc Gap

(3) Tests were conducted to determine the effect of the arc-gap upon the burning time and the burning ratio of the carbons. If the arc gap be increased the current automatically decreases and the positive carbon then burns at a slightly lower rate. Likewise, if the arc gap be decreased, the arc current increases and the positive carbon burns faster.

It is apparent, then, that since a change of current changes materially the burning time of the positive carbon, and only slightly affects the burning rate of the negative, any change of arc gap will change the current and thus the ratio of burning of the positive and negative. This change of ratio tends to move the arc out of focus with the mirror. It is of utmost importance, therefore, that the arc control mechanism be sensitive enough to hold the arc gap constant (5/16 to 11/32 inch), and that the current also be held constant if frequent focusing of the arc is to be avoided.

Lamps having individual feed adjustments for positive and negative carbons, thus allowing the burning ratio to be changed, permit adjustment to any desired current density within the limits of the rating of the carbons.

However, lamps having single-feed screws are necessarily limited in operation to the current density, or burning ratio, for which the screw is designed. Deviation from the given ratio will entail constant attention and frequent manual adjustment.

TABLE I

Arc Voltages and Currents for 7-Mm. Pos. and 6-Mm. Neg. Suprex Carbons

Source of D.C.	Amperes	Volts
Three-Phase Rectifier	40	30
Single-Phase Rectifier	40	27
M-G Set	40	30.5
Three-Phase Rectifier	45	32.5
Single-Phase Rectifier	45	28
M-G Set	45	33
Three-Phase Rectifier	50	34.5
Single-Phase Rectifier	50	29
M-G Set	50	35

(4) In testing the 6- and 7-mm. carbon combination to determine what differences if any occurred in the voltage across the arc when various sources of power were used, single- and three-phase rectifiers and motor-generators were used. In each test the same lamp and the same carbons were used and the same arc gap was maintained under identical conditions. The results obtained are shown in Table I.

TABLE II

Arc Voltages and Currents for 8-Mm. Pos. and 6.5-Mm. Neg. Suprex Carbons

Source of D.C.	Amperes	Volts
Three-Phase Rectifier	50	30.5
Single-Phase Rectifier	50	27
M-G Set	50	31
Three-Phase Rectifier	55	32.5
Single-Phase Rectifier	55	28
M-G Set	55	33
Three-Phase Rectifier	60	34.5
Single-Phase Rectifier	60	29
M-G Set	60	35
Three-Phase Rectifier	65	38.5
Single-Phase Rectifier	65	..
M-G Set	65	39

It will be noted that there is a difference of 3½ to 6 volts across the arc in the case of the single-phase rectifier, and a difference of ½ volt in the case of the three-phase rectifier, as compared with the motor-generator. This difference is due to the a-c. component of the rectified current. The d-c. voltmeter records only the d-c. value, and since the a-c. component is not registered, it is apparent that the greater the a-c. component, the greater will be the difference of voltage as measured with a d-c. voltmeter. Similar tests were made with the 6.5- and 8-mm. carbon trim, with results as shown in Table II.

The tests indicate that the d-c. arc voltage for a given arc gap depends upon the source of the current; but with the 6- and 7-mm. carbons, the voltage will range between 30 volts at 40 amperes and 35 volts at 50 amperes; and in the case of the 6.5- and 8-mm. combination, between 30 volts at 50 amperes and 39 volts at 65 amperes—the figures for both trims being based upon a current supply of acceptable smoothness.

Single-Phase Rectifiers

(5) Single-phase rectifiers do not deliver current of the same smoothness as do three-phase rectifiers. The three-phase full-wave rectifier fills in with overlapping waves the gaps that exist when a single-phase rectifier is used (Fig. 3). Tests were made to determine the visual effect of an alternating component upon the projected light under normal operating conditions and with the shutter running at the standard speed of 90 feet a minute.

With single-phase rectifiers the flicker was easily noticeable; whereas with both three-phase rectifiers and motor-generators there was no discernible flicker. These tests indicated that good screen re-

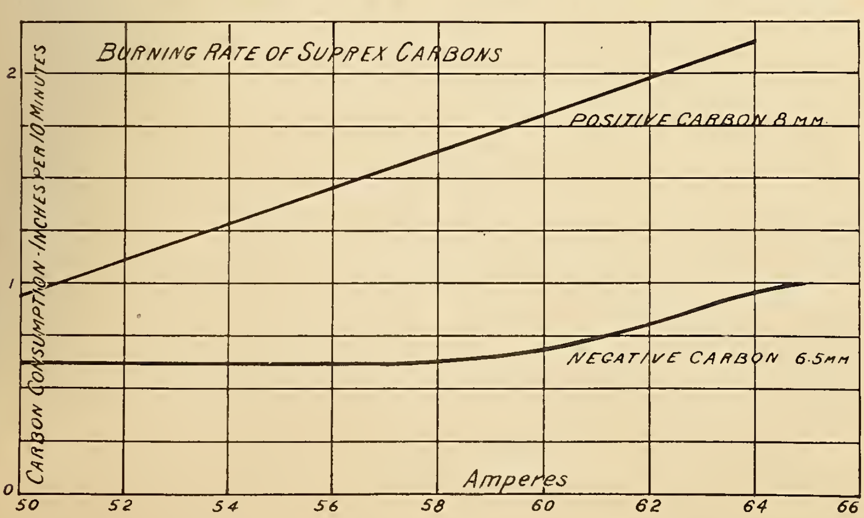
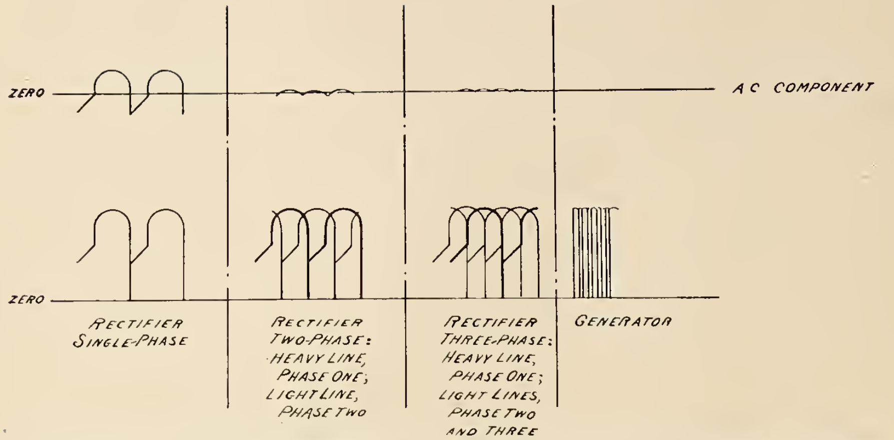


FIGURE 2. *Burning rate of Suprex carbons;* 6.5-*mm. and* 8*mm. combination*



Note: Lower curves show wave shapes from single- two- and three-phase rectifier and from generator. Upper curves show A.C. component from each

FIGURE 3

Illustrating how the three-phase, full-wave rectifier fills in the gaps in the current wave that exist when a single-phase rectifier is used

sults were not attainable with single-phase rectifiers. Both the three-phase rectifiers and the motor-generators delivered satisfactory results.

(6) To determine the change of light intensity for various values of current through the arc, the same optical system and the same measuring instruments were used throughout, and all tests were made with the shutter running. The results are therefore comparative, and are not computed in lumens per square foot (Fig. 4).

Burning the 6- and 7-mm. combination at 42 amperes, the arc consumed 1290 watts and the maximum average light intensity was 54 units. At 45 amperes the arc consumed 1440 watts, and the light intensity was 65 units. Thus, an increase of 11 per cent in wattage afforded a 20 per cent light increase.

Burning the same combination at 50 amperes, the arc consumed 1700 watts. and the maximum average light intensity was 80 units. Thus, an increase in wattage of 32 per cent gave an increase of 48 per cent in light. This over-all increase was thus accomplished with a 19 per cent increase in current, or a 32 per cent increase in wattage. (Fig. 5.)

When the 6.5- and 8-mm. trim was burned at 50 amperes, the arc consumed 1540 watts, and the maximum average light intensity was 70 units. At 55 amperes the arc consumed 1800 watts, and the average light intensity was 84 units. Thus an increase in arc wattage of 17 per cent provided an increase of 20 per cent in light.

At 60 amperes the arc consumed 2100 watts, and the average light intensity was 100 units. Here an increase in arc wattage of 36 per cent resulted in an increase of 43 per cent in light. At 65 amperes the arc consumed 2435 watts, and the average light intensity was 115 units. Thus, with a total increase in wattage of 58 per cent the light was increased by 64 per cent. However, this represents a 30 per cent increase in the current.

(7) Lamps of five different makes, designed for d-c. operation with *Suprex* carbons, were tested and compared on the basis of projected light. The same projector was used in all the tests, only the lamps being changed. The results indicated that although the lamps all had reflectors of different sizes and focal lengths, the projected light in every case was of practically the same intensity for the same arc current.

Various Power Sources

(8) In determining the efficiency and power-factor of the various sources of arc current, the following were considered:

(*A*) 110-volt direct current from power mains.

(*B*) Motor-generator, 80-volt d-c. output.

(*C*) Motor-generator, 60-volt.

(*D*) Motor-generator, 40-volt.

(*E*) Motor-generator, double generator.

(*F*) Single-phase rectifier.

(*G*) Three-phase rectifier.

Measurements were made of the overall efficiency, or the proportion of direct current delivered to the arc with respect to the current drawn from the supply line (including the ballast resistance, in the case of the motor-generator), for a minimum load of 40 and a maximum of 65 amperes. The values of efficiency follow:

A (110-v., d-c. mains) 27 to 36 per cent.
B (m-g., 80 v.) 26 to 35 per cent.
C (m-g., 60 v.) 40 to 45 per cent, at 40 to 55 amperes.
D (m-g., 40 v.) 45 to 48 per cent, at 40 to 50 amperes.
(The limited capacities of the motor-generators in *C* and *D* did not permit testing them with the 60 to 65 ampere arc.)
E (double generator, single-motor type) 45 per cent, at 45 to 50 amperes.
(Not tested above 50 amperes, the rated capacity of the motor-generator.)
F (single-phase rectifier) 48 to 55 per cent, at 40 to 50 amperes.
(Capacity of rectifier, 50 amperes.)
G (Three-phase rectifier) 61 to 72 per cent, at 40 to 60 amperes.
(Although the rated capacity of the rectifier was 60 amperes, the efficiency at 65 amperes was 75 per cent.)

The power-factor of the motor-generator sets tested ranged from 78 to 83 per cent. The power-factor of the single-phase rectifier ranged from 80 to 85 per cent; and of the three-phase rectifier from 85 to 90 per cent.

(9) Examination of reflector mirrors in theatres in which *Suprex* carbons have been used for some time shows that there is continual pitting, resulting in a noticeable decrease in screen light. In order to maintain the screen illumination at its best, the mirrors should be replaced when noticeably pitted.

Mirror Guard Approved

There has been introduced recently a shield, or mirror guard. made with high-quality optical glass and having the same curvature as the mirror it is intended to protect. This guard fits exactly the inside curve of the mirror and acts effectively as a guard against pitting. Various sizes of mirror guards have been tested by the Committee and found to occasion a negligible light loss.

When the mirror guard itself becomes pitted, it can be easily removed and replaced with another, effecting a considerable saving over the cost of a new

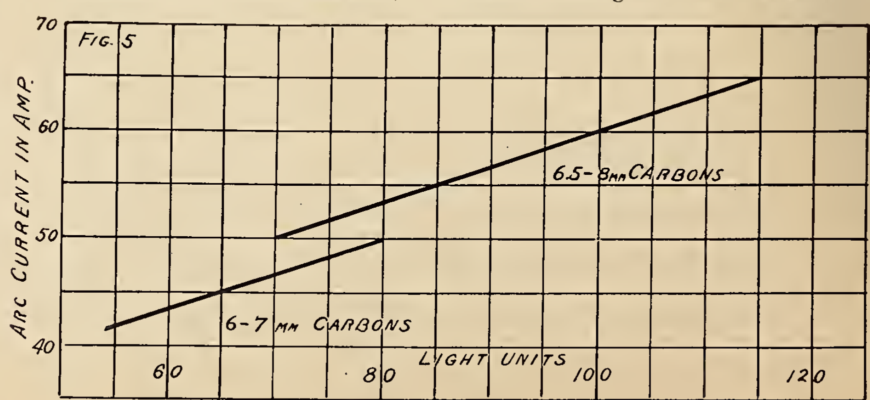


FIGURE 4. *Variation of light intensity with arc current*

Projection Practice Committee

H. Rubin, *Chairman*

J. O. Baker	J. J. Hopkins
T. C. Barrows	W. C. Kunzmann
G. C. Edwards	R. H. McCullough
J. K. Elderkin	R. Miehling
J. J. Finn	P. A. McGuire
E. R. Geib	M. D. O'Brien
S. Glauber	F. H. Richardson
C. L. Greene	V. A. Welman

H. Griffin

mirror. The Committee recommends the use of these guards.

(10) The comparative advantages of the new d-c. light sources using copper-coated *Suprex* carbons may be judged on the basis of two factors: (*a*) quality and quantity of projected light, and (*b*) cost of operation, the latter being of primary importance to the smaller theatres. The following resume of operating costs per hour is based on the prevailing prices for carbons in standard shipping-case quantities, and an average current cost of 5 cents per kwh.:

Carbon Cost per Hour

(6- and 7-mm. trim, allowing for stubs)

Amperes	Cents
40	10.4
45	14.4
50	18.5

Arc Current Cost per Hour

(5 cents per kwh.)

Amperes	Cents
40	6.0
45	7.2
50	8.75

Supply Line Current Cost

(Allowing for losses)

Amperes	D-C. Line and 80-v. Generator (*cents*)	Average Generator (*cents*)	Rectifier (*cents*)
40	20	15	9
45	24	17.5	11
50	29	22	13.5

Low-Intensity Costs, Cents per Hour, at 30 Amperes

Carbon	4.9
Current on line side of motor-generator, 80-volt type at 5 cents per kwh.	19.7
Cost with rectifier	11.5

High-Low Costs, Per Hour

Carbons	17.2
Current from line side of motor generator, at five cents per kwh.	47

From the standpoint of quality and quantity of light, there is no reasonable basis for comparison between these new arcs using the *Suprex* carbons and low-intensity arcs, as there is a pronounced favorable contrast in those respects in favor of the former. The low-intensity carbon arc delivers an intense white light which is very pleasing to the eye. A comparison of the *Suprex* carbon arc with the high-low arc at a current of from 50 to 60 amperes, showed that the *Suprex* carbon arc provides a light of equal intensity but with a more even field—and, of course, at a much lower operating cost.

Suprex Arc Endorsed

The Committee regards the d-c. *Suprex* carbon arc as one of the most important developments in the projection field within recent years. It fulfills the demand for improved screen illumination —both as to quantity and quality of light—in a manner that leaves no room for question. It enables the smaller theatres to offer for the first time a quality of screen illumination comparable with that found heretofore only in the largest and finest theatres. In addition, the Committee's test proved the arc to be economical in operation.

Not only will the screen illumination benefit through use of this new type arc but the general illumination of the theatre can be improved, certainly a very desirable advance. Colored motion pictures, the number of which is progressively increasing, demand a light-source of high-intensity and good quality, a requirement that is fulfilled by this new arc.

The Projection Practice Committee recommends the use of the *Suprex* d-c. arc.

The Committee extends its thanks to the manufacturers who cooperated by supplying the equipment necessary for conducting the tests. The Committee is particularly indebted to the International Projector Corporation, which not only provided quarters in which to conduct the tests, covering a period of two weeks, but also contributed generously of its personnel, equipment, supplies, and electric power.

Discussion:

Mr. Richardson: I believe we should have included in the report the new a-c. light source, which is very economical and furnishes a very excellent projection light.

The statement was made that a glass guard causes negligible light loss. I understand that a loss of at least 4 per cent occurs for each polished surface of glass through which the light passes. You stated that the negative consumption curve rises gradually to a point after which, comparing it with the curve for the positive carbon, the negative burns rather steadily, indicating that the arc will remain at the focus of the mirror. But when the positive burns faster or slower than the negative, the light source will be out of focus constantly. In this particular case it would enlarge the spot.

Mr. Rubin: As was stated in the report, separate feed screws or adjustments for both negative and positive can adjust that. Actually this is a test curve. In the theatre, the arc would be set for 50 amperes, and the adjustment would not be changed.

Mr. Brenkert: As the current increases, the rate of consumption of the positive carbon increases faster than that of the negative. The procedure to follow as the current is increased is to step up the speed of the motor that feeds both carbons, then slow down the negative feed by a separate adjustment. On the arcs put out years ago that could not be done, but it can be done today on most arc lamps.

Mirror Guards Efficient

Mr. Sachtleben: The light reflected by the light-guard will be 4 per cent at each surface, but because the surfaces of the light-guard are concentric with the surface of the mirror, the light reflected from these surfaces, except for second-order reflections and a very slight absorption in the glass itself, will be added to the light from the mirror. This loss of light will be very small, as was found by the investigations of the Committee.

Mr. Brenkert: The best optical glass has a reflection loss at each surface, as Mr. Richardson stated, of 4 per cent. The guard provides two surfaces through which the light must pass on its way to the mirror, and on the return the light must pass through those surfaces again. Four such surfaces must be considered.

Mr. Rubin: In all tests that we made, with any instrument, the loss could not be detected. It can not be detected with the naked eye. That is why we could not report on it. The effect of using the guard

(*Continued on page* 23)

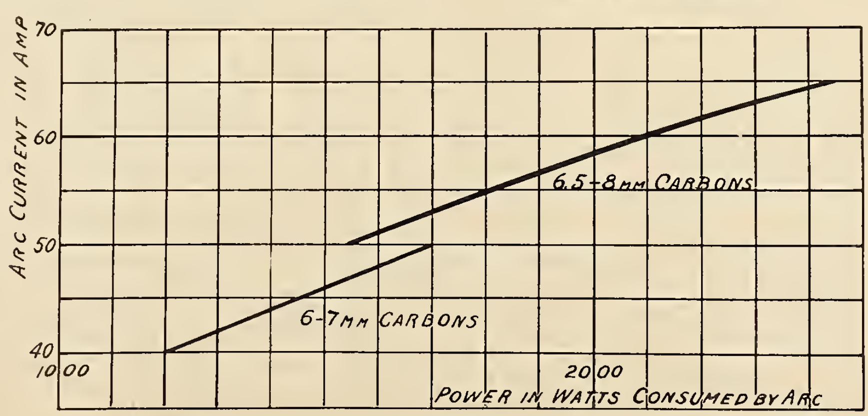


FIGURE 5. *Variation of power with light intensity*

IN THE EDITOR'S MAIL

A. C. Suprex Projection With Rear Shutters

I have read carefully your very good article, "The Suprex Carbon Arc," in your November issue. Your experiences with the A. C. arc differ from those of this company. We have installed about twenty A. C. lamps, and in addition to obtaining about two and one-half times the light produced by low-intensity lamps, we have not found the flicker to be objectionable. The lamps operate on 60 cycles.

There seems to be quite a difference in results when a rear shutter is used. Results with front shutters on A. C. lamps have been pretty bad; but the use of rear shutters seems to effect a vast improvement. Have you made any tests during which this point may have been developed? If you make any future tests, we shall be glad to get the results.

We have had wonderful results with the D. C. Suprex lamps, of which we have installed about thirty. These lamps surely represent a fine advance in projection. Our experience with the mirror guards, which you recommend, tallies with your findings in every respect. So much so, in fact, that we have adopted these guards as standard equipment.

G. F. Perkins
Perkins Electric Co., Ltd.
Montreal, Canada.

[There is no basis in theory or practice for the assumption that better results are obtained by using rear shutters instead of front shutters with A. C. lamps. The flicker which is inherent in A. C. lamps cannot be eliminated, or even minimized, by the use of rear shutters. This opinion stems from a series of exhaustive tests with every type of shutter—whether two-blade, three-blade, enlarged or cut down, synchronous, etc. Elements other than the shutter must be responsible for the improvement reported by this correspondent.

The statement relative to the worth of the mirror guards matches exactly the experience of all impartial critics who have tested them.—*Editor.*]

Wichita, Kan., Exhibits a Little Local Pride

Having read my I. P. for November, I find therein two items which excite my interest. First, your own advertisement on page 27 fails to include this Local as 100% subscribed to I. P. We're just as proud of this as you are.

Second, on page 13 under "Projections" there is mention of a projectionist who was incapacitated by handling heavy film containers. Just this sort of thing precipitated a strike out here in 1919. A projectionist working under contract also acted as shipping clerk. An express employee failed to pick up a film shipment; an exhibitor was disappointed and tried to charge the loss against the projectionist. The battle was on, and a strike was called. When the matter was settled the following clause was inserted in the contract:

The party of the second part [Local 414] . . . agrees to furnish competent men. It is further agreed that projectionists shall not be permitted to carry film to or from exchanges, depots, express offices or other places, nor shall they be required to do other work than that necessary for the proper projection, maintenance and care of the equipment actually used for same.

We should like to see this clause given publicity in I. P., as we believe that the rights of projectionists in this respect should be sharply defined. Personally we have noticed a constantly increasing interest in I. P. among the members, and we know that you will go along to an even greater success.

C. D. Peck
Secretary, Local 414
Wichita, Kansas.

[Our apologies to Local 414 for omitting them from the list of organizations who are 100% subscribed to I. P. Even though the compilation was only a partial list, now that we know it to be a matter of pride with various Locals, we shall be more careful in the future.

The contract clause alluded to by Mr. Peck may seem superfluous in the year 1934, yet precisely the same type of accident described by Mr. Dudiak in his "Projections" column last month is being reported with increasing frequency. Heavy film containers are not something that can be straddled on one finger, or even lifted with one arm, and serious injury can be avoided by exercising caution.—*Editor.*]

Kind Words For I. P. From Minneapolis

I have very little occasion to make any comments on articles appearing in the various trade papers, but I wish to compliment you on your splendid article on the Suprex lamp appearing in your November issue.

Every employee of this branch office has carefully read every word of your article, and we intend to place it before all exhibitors who are prospects for equipment. I should like to have some reprints of this article, if they are available. If not, would you please mail here four extra copies of this issue.

A. T. Crawmer
National Theatre Supply Co.
Minneapolis, Minn.

[The foregoing letter provides an opportunity to express our regrets to all those projectionists, manufacturers and supply dealers who deluged this office with a torrent of requests for extra copies of the Suprex arc article. Although the forms were returned to the press for the printing of 500 additional copies of the November issue, the demand far exceeded the supply. We appreciate this compliment to I. P., even though we find it difficult to hide our embarrassment at failing to service everybody.—*Editor.*]

Suprex Arc, All-A. C. Sets and 16-mm. Projection

Your articles relative to the Suprex arc in your November issue were much appreciated by the writer. We were especially interested in the last paragraph under "Monthly Chat" on page 5.

This is one equipment house that has no "adjustments" to make in the matter of replacing the inferior A. C. lamps. We have consistently refused to sell this type of lamp, and while we did lose a number of sales by this policy, our exhibitor customers are now swearing *by*, not *at* us. We feel that our loss is more than offset by the goodwill gained and the expense we should incur in replacing these lamps.

This also applies to the low-priced, cheaply constructed all-A. C. operated theatre amplifiers that formerly were so numerous. We note that these all-A. C. sets of the better type are now being made with separate rectifiers for circuits where D. C. should be.

Regarding that article on 16 mm. projection: If the new 1,000-watt projector is operated efficiently, it will probably equal the results obtained with certain 35 mm. projection, particularly that type of projection that we see in certain spots. Of course, one must read such articles in the same way one would read patent medicine ads.; it's the "english" that counts.

Further, we must remember that these 16 mm. projectors of the better type are practically foolproof in that we cannot disturb optical alignments, replace mirrors, etc., with inferior products. We have seen some projection lately in elegant (?) theatres having very good equipment that can be matched by 16 mm. equipment. Naturally, if the 35 mm. equipment were to be operated with the same efficiency as is the 16 mm. equipment, there would be a different story to tell. Very much different. Let's have

(*Contnued on page* 23)

Thank You

"I am pleased to advise that our membership has voted to renew its group subscription to International Projectionist for the fourth consecutive year.

"Incidentally, favorable action was taken after only a mere mention that the renewal was due, without any sales talk or other urging. This is in itself a fine tribute to you, the members evidently realizing the value of your very successful efforts to give projectionists a magazine devoted solely to the interests of their craft.

"It is unnecessary for me to wish you continued success, because this is already assured."

Ira Pye
Secretary, Local 650
Westchester County, N. Y.

STEP-BY-STEP ANALYSIS OF COMMON AMPLIFIER TYPES

Aaron Nadell

VII. Practical Ampifier Constants

TABLE A offers an approximate guide to the size of amplifier needed in a given theatre, based on the standards of the leading sound equipment manufacturers, but it also shows, when examined in detail, that it is impossible to specify an amplifier of such-and-such output as sufficient for a given theatre.

Obviously, two theatres having the same seating capacity may vary widely in *real size*, and for this reason Table A lists theatre size in cubic feet and provides a rough guide to just how large a theatre of 100,000 cubic feet is likely to be.

Still another factor, which is not clearly indicated in Table A, is the question of the frequency range of the amplifier. In the same theatre, a system intended to reproduce a top of, say 10,000 cycles, commonly needs *more* power than the identical amplifier tuned to reproduce only 6,000 cycles. This need for additional power when a broader frequency band is covered is especially noticeable in those sound systems that use different speakers for different frequencies (highs and lows) and provide each with its proper sound supply by means of tuned electrical filters. The loss in a filter must be made good, and when an earlier type system is revamped to produce a wider range of sound, an increase in amplifier power is not only a desirable but a necessary part of the process.

Table A likewise shows that it is not always possible to judge an amplifier's power by the type of tubes used in its output stage. The seventh line of the table indicates that an output stage of two 242-type tubes may be capable of from 10 to 24 watts output. The difference is chiefly a matter of the plate and grid voltages applied to the tubes. The same considerations apply to the bottom line of the chart, which shows that an output stage of four 242-type tubes may rate between 20 and 48 watts of sound power. But it is possible by means of this chart to arrive at a rough conclusion as to the power of a sound amplifier by estimating the size of its output tubes.

Loud speaker efficiency is another factor that must be weighed when any such judgment is attempted. Table A is based upon the assumption of reasonably efficient speakers, such as are used by the better manufacturers. Substitute less efficient speakers, of the cheaper radio type, and all the output ratings of Table A must be multiplied by 2 at least, and probably by 4, to supply theatres of the sizes indicated.

With the above qualifications in mind, Table A should prove a helpful guide in selecting an amplifier for any theatre. It will certainly prevent the mistake sometimes encountered, where a 25-watt amplifier is bought for a house of 300 seats or a 3-watt amplifier for one of 1,000 seats.

Table A. Power Rating of Amplifier

Type of Tubes in Output Stage	Output Power in Watts	Theatre Size in Cubic Feet	Number of Seats in Theatre
TWO TUBES IN OUTPUT STAGE			
245	3	42,500	300
2A3	6	120,000	800
250	10	200,000	1,400
845	40	1,100,000	4,000
205	2	100,000	800
275	6	100,000	800
242	10-24	100,000-600,000	800-2,800
FOUR TUBES IN OUTPUT STAGE			
245	6	85,000	600
250	20	600,000	2,500
242	20-48	over 600,000	over 2,800

The projectionist who is responsible for the functioning and repair of an amplifier should know the voltage and current at every set of socket terminals. Voltmeter tests at socket studs constitute one of the fastest methods of finding amplifier troubles, but unless the normal voltage and current are known, the tests have no meaning. Amplifier manufacturers should furnish the necessary facts to the theatre, and in most cases will be glad to do so on request.

Socket Voltages and Current

Table B gives the filament constants for most common types of theatre tubes, but, as explained above, the plate and grid constants may be varied by the amplifier manufacturer according to the power and quality he wishes to build into his apparatus, and cannot usefully be shown on any chart. Filament current and voltage are not variable to any appreciable extent, and any of the tubes shown in Table B will operate satisfactorily at the filament values there given. Since the projectionist cannot rely on any general tube chart, or even on the tube data that comes with every carton, for plate and grid constants, the specifications of the amplifier manufacturer are vital to him in that respect, and when not obtainable should be replaced by meter readings taken under normal conditions and recorded for reference.

Concerning Resistors

Resistors are calibrated not only in ohms but also in current or wattage. It is obvious that a light 5-ohm resistor used to control the filament of a vacuum tube cannot be made to substitute for the heavy 5-ohm resistor that may be used as part of the arc ballast, or as a d.c. battery-charger. The difference is in the amount of current flowing, and therefore in the quantity of heat the resistor must be able to dissipate without burning out.

In ordering resistor replacements from the manufacturer of any amplifier it is only necessary to give the type number of the part, or its precise position and function in the circuit; but other sup-

Table B

FILAMENT CHARACTERISTICS OF THEATRE-TYPE TUBES

Type	Fil. Volts	Fil. Amps.
224	2.5	1.75
226	1.5	1.05
235	2.5	1.75
256	2.5	1.00
257	2.5	1.00
2A3	2.5	2.5
210	7.5	1.25
250	7.5	1.25
245	2.5	1.5
845	10.0	3.25
864	1.1	2.5
280	5.0	2.0
281	7.5	1.25
866	2.5	5.0
102D	2.0	0.97
205	4.5	1.6
211	10.0	3.0
242	10.0	3.25
264	1.35-1.65	0.3

pliers cannot be expected to know that manufacturer's design, and orders to them commonly specify either wattage or current, as well as resistance in ohms.

In this respect current and wattage amount to the same thing for practical purposes. The heating effect is, of course, the result of the wattage consumed in the resistor:

$$\text{Watts} = I \times E$$

But

$$E = I \times R$$

Therefore I x R can be substituted for E (since it is the same thing as E) in the first equation given, making that read:

$$\text{Watts} = I \times I \times R$$

Consequently, the heat loss of a resistor, which is an effect of the wattage consumed, is also an effect of the I x I x R, or I^2R, of the resistor, since I^2R and watts are the same thing. It follows that resistor requirements are specified equally well by citing the resistance and the current, or the resistance and the wattage. In either case the supplier will be able to furnish an instrument suited to the purpose. In selecting a resistor type from a manufacturer's catalogue the projectionist may apply the foregoing equations to the choice of the exact part he needs, regardless of whether the catalogue lists those parts under current or wattage.

To find the wattage of a resistor when only the current is known, multiply current by current resistance. To find the current when only the wattage is known divide wattage by resistance, and the figure obtained will equal current multiplied by current, or I^2. Then, if I^2 turns out to be 100, I will equal 10, and so on.

There is no harm—on the contrary, an advantage of safety—in choosing a resistor of somewhat more than the required current or wattage rating, so long as the resistance in ohms is duplicated exactly.

Condenser Ratings

Condensers are rated for voltage as well as for capacitance. The voltage rating of a condenser is that potential difference which the instrument can withstand safely for prolonged periods of time, and cannot be judged by the rated capacitance. A 2 micro-farad filter condenser designed for work with a 110-volt line will break down instantly in smoke and smell if substituted for a 2 micro-farad filter condenser in the 1,000-volt plate circuit of a large theatre amplifier.

The working voltage that any condenser used in an amplifier must be able to withstand can be judged by considering the wiring diagram and the known constants of the socket terminals. Tracing the wires backward from socket terminals to the condenser in question, and studying the circuit, should indicate in every case the precise voltage to which the condenser is subject, taking into consideration any voltage drop which may have taken place between the condenser and the socket. Such voltage drop may be caused not only by a resistor, but equally well by the resistance of a choke coil or of a transformer winding.

Condensers are rated by both a.c. and d.c. voltage. The reason is that insulation can puncture in a fraction of a second—namely, during that brief instant of time when the a.c. voltage has reached its maximum, and therefore is nearly half again as high as its rated value. The voltage of a 110-volt line reaches momentarily to 150 volts twice during each cycle, or 120 times a second in the case of 60-cycle current.

The *effective* voltage, taking a second of time as a whole, is only 110, but a condenser that could safely withstand 110 volts of steady d.c. might easily be punctured during the instantaneous 150-volt peaks of an a.c. line of identical rating. If only the d.c. rating of a condenser is known, choose one rated at least 4/10ths higher for use on a.c. voltage. If the a.c. rating of the condenser is known, it can with safety be used on d.c. voltage not more than 3/10ths higher.

Electrolytic condensers cannot be used with a.c. of any voltage.

Transformers and Inductors

Power transformers are rated by primary voltage, and by the voltage and current requirements of every secondary. Low-grade transformers that meet these specifications will nevertheless show a tendency to burn out when used continuously for long hours, as in theatre service. It is necessary, therefore, when ordering such parts from any except makers of known reliability, to specify that they are intended for continuous service. In the case of suppliers of dubious reputation (if it be necessary to deal with such) it may also be advisable to exaggerate slightly the *current* drain on the secondaries, taking care to give all the voltages precisely. This method of ordering should insure receipt of a satisfactory instrument.

Choke coils used as part of a rectifier filter are commonly rated in henrys of inductance, and in the current they are required to carry. Where the inductance in henrys is not known, and replacement cannot be obtained from the original source, give the current and the number of turns of wire and the inner diameter of the coil. If it is not practical to state the number of turns, at least give the inner diameter of the coil, the outside diameter (less wrapping), and the size and type of insulation of the wire, from which facts the number of turns can be calculated with some approximation of accuracy. But the inductance in henrys should be obtained from the original supplier before replacement becomes necessary. Measuring that inductance is not a projection room job.

Speech Transformers and Coils

Since the constants of speech windings are far from simple, it is fortunate that the number of manufacturers of such windings is not large. Few amplifier makers use their own coils, although they may use coils that bear their own nameplate. This is sometimes true even of the largest companies, who are popularly supposed to wind their own.

The result is that a reputable specialist in speech windings is likely to know all about the constants of practically every make and type of coil and transformer in America, and it is only necessary to ask such a maker to supply a winding to replace Company Z's type so-and-so. The projectionist is more likely to get exactly what he wants, and there is a reasonably good chance that he will get the identical instrument, built into a different shell and carrying a differ-

Still Another

"I am glad to be able to send to you the names of all the projectionists and some of the stagehand members of this organization as a bulk subscription to INTERNATIONAL PROJECTIONIST.

"We feel sure that this is one of the best investments our Local Union membership has ever made."

JOHN E. MURPHY
Sec. and Bus. Rep., Local 96
Worcester, Mass.

ent name-plate. In the case of power transformers, resistors or condensers, the makers of which are really numerous, an order so worded would result only in a request for further information.

However, orders for speech windings based on type numbers must be sent to a really large *maker* of such windings (not to a *dealer*) and must carry the type number of the coil or transformer, as given on its case, not the type of amplifier in which it is used. Even then it may happen, occasionally, that the supplier will need further data.

Speech circuit choke coils are rated in current, in inductance, and in frequency range (which last is not necessarily the same thing as the frequency range of the amplifier as a whole). Exact duplication, from any other than the original source, may not always be possible. It can be approximated, however, by stating the circuit in which the coil is used, its function in that circuit, and the types of tubes in that stage of the amplifier.

Where the coil is used as part of a speech band filter it will be necessary either to state the inductance or to submit a precise description and drawing of the filter, with all condenser values, and tell accurately just what bands of frequencies it is intended to pass or to stop. From this data and a standard filter formula the supplier can calculate the inductance required. It will check his calculations, and the projectionist's data, to give the diameter and number of turns of the original coil, and, if possible, to send him its core. But all this is make-shift at best. In the case of some filters the exact inductance will not matter very greatly, but in other instances precision in this respect is vital, an error so small as five per cent being sufficient to destroy the filter action. Where the filter coils have to be obtained from any source other than the original supplier, it is very desirable to obtain exact data in advance.

Speech transformers are rated as to each winding, which must be known with respect to current, inductance and frequency range. In addition, the ratio of primary to secondary turns must be given. It is also common practice to state the impedance (at 1,000 cycles) of each winding. Such data is seldom completely available in the projection room, and cannot be obtained there by any practical methods of measurement. Roughly satisfactory results can be had by ordering, say, "an output transformer, secondary impedance 15 ohms, to work from a pair of 245 tubes in push-pull, in an amplifier having a frequency range of from 50 to 8,000 cycles".

Inter-tube coupling transformers may be specified in the same way, omitting any mention of impedance and stating merely the types of tubes to be coupled, and whether they are single tubes or push-pull pairs. But if the amplifier is of recent design, there is a possibility that some of its tubes are operating as Class B. That possibility must be checked, as explained hereafter, since it will make a great difference in the constants of the speech transformers.

On the whole, it is fortunate that in so many cases it is possible to order merely a replacement for P company's type Q transformer, and secure perfectly satisfactory results.

The rating of an amplifier in frequency range can often be improved bv changing the input, output and coupling transformers. The details may prove involved, but a transformer company is often willing to solve them for the asking. Send such a company a circuit drawing of your amplifier, giving all the constants you know or can find out, including socket terminal voltages and currents, tube types, resistor values in ohms, condenser values in micro-farads, and transformer and choke coil type numbers.

If improvement be practicable, the transformer maker can advise the exact changes needed and specify new transformers. But it is always necessary to remember that increased frequency response in the amplifier is no help unless the optical system can put a wider range of frequencies into the photo-cell, and the speakers can make use of a wider range when the amplifier delivers it. The frequency range of those parts does not, generally, rate nearly as high as that of even a moderately good amplifier.

Rating of Amplifiers

Amplifiers are rated in power by their wattage output, which means the power in watts supplied to the speakers. This last has nothing to do with the power *consumed* by the amplifier. For example, referring to Table A, the amplifier there rated as having an output of 40 watts undistorted audio power consumes 800 watts of line a.c. for its operation, or twenty times its speech wattage.

The amplifier noted in the eighth line of Table A, with 6 watts of undistorted audio output in its speaker circuit, adds 300 watts an hour to the theatre's monthly electric bill, or fifty times its sound power. The difference is lost in heating filaments, in the relative efficiency of power transformers, in the voltage drop across resistors and coils, and in the tubes themselves.

The power output of amplifiers is also rated in *decibels*. Table C shows the *output level*, in decibels, for amplifiers having the wattage outputs given in Table A. Study of Table C reveals that doubling the output power in watts always adds three decibels to the level.

For example: the second line shows that an output power of 3 watts is equal to the output power of 27 decibels, just as 3 feet equals one yard. But a 6-watt output, twice as great, is equal only to 30 decibels, a gain of just 3 db. Then a 12-watt output should equal 33 db., and one of 24 watts, 36 db. The sixth line of the table shows this last, and the bottom line shows that increasing the level in watts from 24 to 48 raises the output in decibels from 36 to 39.

Referring to the fourth line of Table C.—10 watts, 32 db; fifth line, 20 watts, 35 db; seventh line 40 watts, 38 db; Power doubles each time; decibel rating increases in steps of 3.

Therefore, in the case of any volume control calibrated in decibels, every increase of three db. in the volume setting doubles the sound output in watts. Now, if the volume control indicates that the theatre needs an amplifier with, say, 3 additional db. of volume, then the new amplifier must be twice as powerful as the old one, in wattage rating; if 6 additional db. are needed the new amplifier must be four times as powerful; eight times as powerful for 9 additional db., and so on.

Amplifiers are rated according to gain, or amplifying power, as well as by output power. Amplifying power is commonly measured in decibels, but decibels of gain and decibels of output power are two different things. The output *level* of 39 db., shown in Table C, may represent a *gain* of 79, inasmuch as the original photo-cell current was, possibly, 40 db. below zero. In that event the 48 watts output power corresponding to an output level of 39 db. represents an amplification of 90,000,000, in watts, over the original wattage output of the photo-cell.

Finally, amplifiers are also rated as to (*Continued in Col. 1, next page*)

Table C

OUTPUT POWER

Watts	Decibels
2	25
3	27
6	30
10	32
20	35
24	36
40	38
48	39

Industry Ills

Greta Garbo, whose popularity as a motion picture star seems definitely on the decline, will receive $300,000 for her next M-G-M picture. This is a tidy increase over payment for her last, a paltry $270,000.

Meanwhile Claudette Colbert will have to struggle through six pictures in the next two years for the comparatively insignificant salary of $480,000.

A YEAR OF THE MOTION PICTURE CODE; WHAT NEXT?

James J. Finn

JUST one year after President Roosevelt approved the motion picture code we are treated to the spectacle of his former chief codist, General Hugh Johnson, announcing through the newspapers to all and sundry that "the NRA is as dead as a dodo; and the only thing deader than a dodo is a doornail." Pretty words, these, worthy of an unchallenged authority on dodos.

Is this former chief codifier correct? Generally speaking, and having in mind the NRA panorama the country over, one must agree with General Johnson. Of course, it is only a small detail that the chief cause for the advertised demise of the NRA is none other than Johnson himself.

Johnson could blow hot, he could blow cold, but he couldn't blow hard enough. The goings-on in other industries with other codes indicate clearly just what is going to happen ultimately to the motion picture code.

Frankly, this writer believes that the NRA, as we have known it do date, *is* as dead as a dodo. Just as prohibition foundered on the rocks of ineffectual enforcement, so was the NRA strangled by lack of compliance. Of course, the NRA big-wigs in Washington are now talking seriously and sonorously about compliance, but they might just as well attempt to breathe life into a dead horse. The answer to the proposition lies in one word—compliance, or, rather, non-compliance.

Acceptance, Not Compliance

So long as the NRA was received with open arms by a given industry, the leaders of which disdained to chisel, then just so long was a given code worth a hoot. But the moment industrial leaders put up their backs and made threatening gestures in the direction of deputy administrators, the National Labor Board, and the compliance division—from that moment on a given code started to wither away. The motion picture code bears out the truth of this statement.

In San Francisco, in Boston, in Cleveland, in Chicago, in Philadelphia—in any city where more or less cordial employer-employee relations had been maintained through the years, and where good working conditions and wages were in effect—the NRA had no trouble at all in proving itself the saviour of the working man. But in those localities where there existed any employer-employee disturbance—witness New York as a shining example—there NRA flopped.

There is a tendency to identify the New Yorks of this land as exceptions; but isn't it a fact that the NRA was widely advertised as a cure-all for the New Yorks? Certainly. Surely the Bostons, the Clevelands, the San Franciscos didn't care a whoop in a stiff gale about the NRA.

As previously stated in these columns, the motion picture code is purely a negative exposition of labor's position in that it merely okayed things exactly as they were and cared nothing about improvement. The noble attempt to lift wages to the level of 1929 finally worked out so that not a dime of the money lost in motion picture wages between 1929 and 1933 was recovered. Not a dime. But, has anybody seen prettier figures than those imbedded in the latest financial reports of the largest exhibitors in this business? These figures are most interesting.

Collective bargaining, supposedly guaranteed in the now famous Section 7a of the Recovery Act, never meant a thing to workers in the motion picture field because the union membership was distributed too thinly among the theatres. Which is well, because the interpretations now being visited upon that cornerstone of the NRA by such "friends" of labor as Donald R. Richberg make of the section not a help but a positive peril to labor.

Labor's trouble was and still is that it went whole hog for the NRA. It has been playing along with the fanciful notion that employers, prodded by the Government, would eventually give that which they showed absolutely no disposition to give through years past, even when 1929 poured its imaginary wealth upon the land. Right at the moment labor and the Government appear to be engaged in some form of shell game, participated in by the usual quota of shills in the form of lawyers, pseudo labor leaders and whipper-snapper deputy administrators. Most of the latter soon will be wending their ways back to jobs in those industries which they now oversee.

After the NRA, What?

Last February, at a dinner given by the Easton, Penna., Local 203, this writer said that it was time to consider the after-effects of the NRA, the passing of which would leave a vacuum to be filled by that group which displayed the greatest celerity in moving into action. The day the code was signed, he continued, the code was definitely behind the craft, and future activity should be directed toward preparing to return to the old days of job bargaining. Prophetic words, indeed, the truth of which was proven all too soon.

The best interests of motion picture workers will be served if all units thereof consider the code as dead. It may live on for a while yet, true, but its span of life will be akin to a dying man. In fact, there are many shrewd labor men who desire that the NRA be abolished, preferring to go it alone rather than hobble along on a rubber crutch.

The much-advertised new form for the NRA, which will be presented to the next Congress, likely will be as impotent in protecting labor as was its predecessor. There exists no lack of evidence tending to show that the recovery program has veered sharply to the right, with big business in the saddle and practically directing the activities of the deputy administrators and numerous other recovery officials.

It isn't far-fetched to say that NRA is directly responsible for the rotten labor conditions existing today in many localities. The NRA kept stalling along, even in the face of flagrant and open code violations, kept making promises and threatening action that never came off and thus acting as a barrier to a settlement between the warring factions. Indeed, if the leading lights of the NRA were one-half as courageous and sincere as were the various Regional Boards over which they exercised authority, these lines could not possibly be written. One of the bright lights of the whole NRA program was the courage displayed by these Regional Boards.

Thousands of projectionists and other theatre help are working today for wages far below those prescribed by the code labor provisions. NRA might answer that it cannot possibly check up on every theatre in America; but the truthful answer would be that nobody wants to present a complaint to NRA or any-

(Continued in Col. 1, next page)

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class, falling, in the case of theatre types, into Classes A, B, and A Prime. The difference is a matter of the constants of the circuits—of the grid bias primarily, but also of plate current and speech transformer constants. The Class A Prime is an intermediate type that operates as Class A until a high level of volume is reached, when an automatic change in grid bias takes place and the amplifier functions as Class B until the volume is again reduced.

Any amplifier using tubes about the sizes charted in Table A, but delivering several times as much power in watts per filament, is undoubtedly operating as Class B, or A Prime. Manufacturers will, however, rate their amplifiers as to class upon request.

PROJECTION RECTIFIERS: SINGLE- AND POLYPHASE TYPES

J. K. Elderkin

FOREST MANUFACTURING CORPORATION

IT WAS stated in this publication (Nov. issue)[1] that single-phase rectifiers are unsatisfactory for use with the new lamps burning Suprex carbons. This statement is correct; but some readers may have glossed over its limitation and concluded that this type rectifier is unsuited to any projection purpose. This is not so.

Single-phase rectifiers of proper design are satisfactory for low-intensity projection work; but they are wholly unsatisfactory for either high-intensity or Suprex arc operation. Why? Because it is the *combination* of shutter action, the single-phase rectified current, and the *intensity* of the projected light that creates the unsatisfactory condition.

In support of the foregoing the following facts are presented:

With A. C. arcs using 60-cycle current, the front carbon is the only one in focus with the mirror and is alternately positive and negative 60 times a second. When the carbon is positive, light is projected to the screen; but when the carbon is negative, very little light is projected. It follows, therefore, that the screen is alternately bright and dim 60 times per second.

With the shutter idle, the flicker will not be apparent because of the inability of the eye to follow such rapid changes in light intensity, the result of the phenomenon known as "persistence of vision."

Now let us consider the character of the light projected by an arc supplied with D.C., in which case the carbon in focus will be positive constantly and the projected light will be of constant intensity. Such a light, however, will appear no different to the eye than that projected from 60-cycle A. C. arc—*without the shutter running.*

We can now consider the effect of shutter action. Having two blades and two openings, the shutter, running at normal speed of 24 revolutions per second, will cut off the light on the screen twice with each revolution. Therefore, the frequency of the projected light from the D. C. arc, due to shutter action, will be 2 x 24, or 48 cycles, per second, which, if the light be of high intensity, can be detected by the human eye.

This effect may be termed *inherent flicker*, since it is a characteristic of the projector and bears no relation to the nature of current supplying the arc. The degree of visibility of this flicker depends upon only two things: the intensity and the color of the projected light.

Effect of Shutter Action

It has been noted that light projected by a 60-cycle A. C. arc has no visible flicker, but that light projected at a frequency of 48 cycles does present a visible flicker provided the intensity of the light be high enough. Now, it is obvious that the lower the frequency below 48 cycles the more noticeable will be the flicker. In other words, while projected light interrupted 60 times per second appears to be uninterrupted, and light interrupted 48 times per second is passable, if we interrupt the light at a rate considerably lower than 48 times per second, the result will be highly objectionable flicker.

The logical question now presents itself: If we project a light that is interrupted 60 times per second, and then cut into this light with a shutter that in itself interrupts 48 times per second this *already interrupted* light, what is the result? The result is stroboscopic and the difference between the two frequencies is manifested by a very objectionable flicker.

The only cure for this situation would be to either speed up the shutter to 60 interruptions per second (not practical), or to supply the arc with current having a frequency of 48-96 or 144 cycles. Or, possibly, have a difference between shutter frequency and supply current of at least 48 to 50 cycles (also not practical).

The type of shutter used has no bearing on the results obtained. This writer has used all types of shutters—wide blades, narrow blades, uneven blades, "flicker blades", synchronous and non-synchronous, and combinations of all, but with no other results than those enumerated herein. If it were not for the shutter, screen results would be the same irrespective of power supply, but unfortunately we must use a shutter.

It was stated previously that single-phase rectifiers are acceptable for low-intensity projection but not for any other type of projection. Why? If we supply an arc with current rectified from single-phase A. C., the carbon in focus is always positive and therefore projects a light of constant intensity. However, this rectified current has a ripple corresponding to the A. C. from which it is derived.

The magnitude of this ripple depends upon the design of the rectifier, some of which may have more ripple than others. If this be so, then, why is a single-phase rectifier considered as being satisfactory for *any type* of projection arc? The answer is: because the higher the amperage required from a single-phase rectifier, the more difficult becomes the problem of filtering or removing the ripple.

If we had to deal only with current of 8 to 10 amperes at 10 to 12 volts, we could build a filter having sufficiently large chokes and condensers to practically eliminate the ripple. It is an entirely different matter, however, to filter 25 to 60 amperes at from 35 to 60 volts. This writer, with extensive experience and a wide knowledge of available filters and condensers, knows of no filter that would effectively remove the ripple from, say, a 25-ampere, 50-volt rectifier.

A good single-phase rectifier, then, is one in which the ripple is reduced to the lowest possible limit, the accomplishment of which requires the use in the rectifier of sufficient inductance. The latter may be done wholly within the transformer by proper design, or it may be in the form of a choke or chokes placed in the rectifier circuit either ahead of the rectifying element or in the output circuit.

What is the effect of this ripple upon the projected light? Since the carbon in focus is always positive, there is al-

[1] "The Suprex Carbon Arc," J. J. Finn, page 7.

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body else and then await the passage of eight or ten months before a decision is forthcoming. Usually, too, the decision would be a perfect example of straddling and pussyfooting.

Numerous individual cases could be cited in support of the foregoing estimate of the NRA, but there remains to be said only that the NRA is, as the distinguished General Johnson said, dead as a dodo. All that need be done is to write its obituary notice.

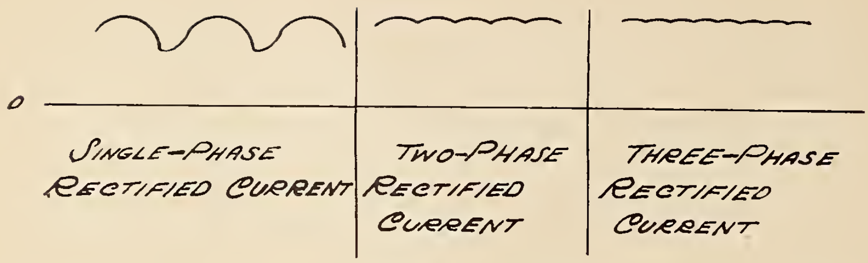


FIGURE 1

ways light on the screen; but the arc current varies *exactly in accord* with the ripple—that is, at the crest of the wave a little more current passes to the arc than at the valley, or trough, of the wave, and consequently the light projected at the crest is brighter than at the valley of the wave.

If the rectifier be of good design and have a capacity of from 15 to 30 amperes, the ripple remaining in the current will not be reflected in the screen light, because sufficient inductance can be built into a single-phase rectifier of 30 amps. capacity to suppress the ripple to a point where it will not be noticeable to the human eye—even with the shutter running at normal speed.

However, the same amount of ripple would be very noticeable in either high-intensity or Suprex projection, because these types of light are not only white as compared with the yellow light of the low-intensity arc but are of much higher intensity. Thus we return to the point made previously: the vital factors are the color and the intensity of the projected light.

The answer to the question posed previously is that the higher the amperage requirements the more hopeless becomes the single-phase rectifier, the more ripple must be tolerated in the rectified current. Suprex arcs require at present from 45 to 65 amperes, an amperage level that precludes any thought of utilizing single-phase rectifiers.

Polyphase Rectifiers

A polyphase rectifier is one that is designed to work from A. C. having more than a single-phase, such as two- or three-phase. A two-phase A. C. supply consists of two single-phase currents, one of which is 90 degrees out of phase with the other. This means that when the current falls to zero in one phase, the current in the other phase is at the peak.

Let us assume that we have two single-phase rectifiers side by side. We connect the A. C. input wires of one rectifier across one phase of the two-phase supply line, and we connect the other rectifier across the other single-phase of the same supply. Next, we connect together the positive output wire from each rectifier, and then we do the same with each negative output wire.

Now, each rectifier will in itself give a single-phase rectified current. This current will naturally have a ripple, but the ripple from one rectifier will be exactly 90 degrees out of step with the ripple of the other rectifier, because each is being supplied with a separate phase of the two-phase supply. Because of this circumstance, when the current from one rectifier is at the crest, the current from the other is at the valley of the ripple.

Since the output currents from both rectifiers are tied together, it is apparent that the action of one compensates for that of the other with respect to peaks and valleys of current, the net result being that the arc in this case would receive current of even value or practically without ripple.

The three-phase rectifier operates on the same principle, except that we consider three single-phase rectifiers working on a 60-degree phase difference, instead of two rectifiers working on a 90-degree phase difference.

A three-phase supply system may be changed to one of two-phase with the rectifier transformers by means of the "Scott Connection", and the resultant two-phase current then rectified. Figure 1 illustrates the ripple from single-phase, two-phase and three-phase rectifications.

The D. C. output from a properly designed polyphase rectifier will not occasion any objectionable ripple and will afford a supply of pure D. C. to the arc. The current from this type rectifier is admirably suited to both the straight high-intensity and the Suprex projection arcs.

To sum up: (1) A. C. is acceptable for spotlight or effect work, but is unsatisfactory for motion picture projection; (2) single-phase rectifiers of proper design may be used for low-intensity arc projection of motion pictures, or for spots, effect-machines, etc., but they are wholly unsuited for use with either Suprex or other high-intensity arcs; and (3) polyphase rectifiers of proper design are perfectly satisfactory for any projection purpose.

[NOTE: The foregoing article was prompted by a reader's request for information on the points discussed therein, thus proving the value to the craft at large of reader cooperation in making known their editorial preferences. Additional data relative to sources of power supply, or information on any projection topic, will be supplied upon request.—*Ed.*]

REFLECTOR SHIELD IS NEW MIR-O-GUARD NAME

Reflector Shield Co. is the new name of the Theatre Equipment Co., which is handling the manufacture and distribution of Mir-O-Guard, which protects the reflector against pitting. These guards will be known in the future as Reflector Shields.

The address remains the same at 235 Fourth Ave., New York City.

CARBON CHARACTERISTICS

Do you know that pure carbon in one form is the whitest and hardest substance; while in another form it is one of the softest and blackest. This is due to a slight difference in atomic structure. Incidentally, while we are on the subject of carbons, it may interest users of high-intensity reflector arc lamps to know that carbon consumption at 65 amperes is in the order of three positives to two negatives.

N. Y. APPEALS COURT DEFINES SEC. 7-A

NRA's torturous path in the courts was marked by another adverse decision when the New York State Court of Appeals recently reversed an order of the Appellate Division which granted a temporary injunction to Harry Sherman, as president of Local 306, New York, against 14 members of the I. T. O. A., exhibitor body. The injunction was accompanied by an order compelling the reinstatement of 55 members of Local 306 in theatres which dismissed them upon termination of contracts.

Local 306 claimed that the men were discharged after the President's re-employment code was signed and in violation of both the motion picture code and the N. Y. State law supporting all codes.

The decision, in which all Appeals Court members concurred, declared that Section 7a of the NRA "is not aimed at the right of employers to select or discharge employes but at *interference* with the right of employes to select representatives of their own choosing." The opinion held that the evidence indicated that the contract between the workers and the employers had expired before the new workers were engaged, and that there was no dispute about wages or conditions of employment.

Right to Discharge Stands

"Employers may discharge or hire at will, unless prevented by valid law of contract," continued the decision. "The right of employes to have representatives of their own choosing is not involved in this case . . . .

"Earlier court opinions have stated that such union members have a valid interest in the working conditions of persons employed in similar occupations. It does not follow that such a union has an affirmative right of action under the Recovery Act or the State law solely because of economic or social interests. Nor do we think the word 'interests,' as used

in Section 3 of the State law, was intended to have so broad a meaning.

"If it were otherwise, there is a possibility that organized labor might find its hard-won extra-judicial remedies of strike, boycott and picketing imperiled."

The basis of the Local 306 case was that, quite apart from the issue of contract expiration, the exhibitors had fired its members in order to make room for members of a dual organization which, Local 306 charged and according to decisions by both the Regional Labor Board and the lower courts, was a company union the members of which were absolutely under the domination of the employers.

Thus, even though the discharge in itself be legal, charged the Local, its effect was to bring about a violation of recovery measures. This charge appeared well-founded, since only 30 dual organization members replaced the 56 Local 306 men. This point appears to have been lost in the shuffle of court proceedings, whether due to legal incompetence or what is not known.

The exhibitor defense was that they were complying with the NRA; that anyhow the NRA violates the U. S. Constitution; that Congress had no power to enact the law, and that it provides for "excessive punishment."

The P. R. A., continued the owner's defense, became "academic" after the film industry code was signed in December, 1933; and, in any event, neither Local 306 nor anybody else had any right to sue under that code.

"LENS DESIGN", BY RAYTON

An interesting paper entitled "Lens Design" was presented by Wilbur B. Rayton, of the Bausch & Lomb Optical Co., at a recent meeting of the Atlantic Coast Section of the S.M.P.E. This paper, in non-mathematical language, will be published in these columns in the near future.

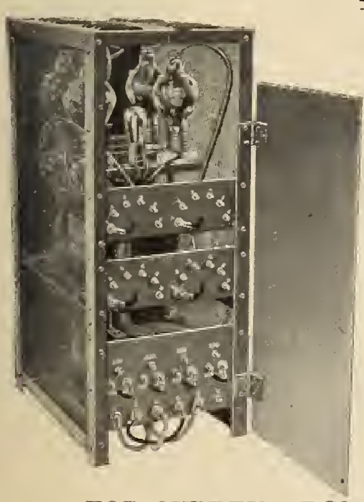
PROJECTION CREW HEROES IN NEW YORK FIRE

Fire in the auditorium of the Strand Theatre, first de-luxe picture house on Broadway, N. Y. City, provided the setting for a remarkable display of coolheadedness and heroism on the part of two projectionist members of Local 306, N. Y. After burning fiercely for some time under the roof and over the theatre auditorium, the fire broke into the theatre, showering sparks and giving off dense clouds of smoke.

Amazing Rescue Feat

The alarm was sounded, and the patrons began to file out. The manager requested that the projectionists stick to their posts and continue projecting the picture just as long as they possibly could, as an aid in maintaining order among the crowd. This was done.

When conditions became unbearable,



the projectionists, seeking escape, found every exit cut off by the flames and smoke. One of them, Marcus Rittiner, was overcome by smoke and collapsed. His partner, Walter Pitchert, broke through a small window in the room and dropped a not-too-thick cable down alongside the building. Picking up Rittiner, he climbed out onto the cable and, burdened by his partner's weight, worked his way down the face of the building to a lower floor, where he swung in and was helped by willing hands.

This heroic deed was witnessed by some 10,000 persons who milled in Times Square watching the fire. Fire department officials expressed amazement at Pitchert's rescue feat and extended their appreciation for the courage displayed by the men in staying at their projection room posts.

The rescue story, including detailed reference to the courage of the men in keeping the picture on the screen, made the front page of every metropolitan newspaper.

L. U. 182 Denies Part in N. E. Bombings

Four New England theatres in three different cities were bombed at the same hour early in the morning of December 12. The houses were the Tremont and Majestic, in Boston; the Capitol, in Lynn, and Capitol, in Pawtucket, R. I. Damage on all four houses is estimated at $15,000. No one was injured.

Governor Ely of Massachusetts, incensed at the bombings, demanded that "the terrorists be brought to justice." Boston police ascribed the bombings to a group of New York professionals, said to have been paid from $250 to $1,000 for each job. The theatre owners, none of whom use A. F. of L. members, bluntly charged the work to the Boston M. P. Operators Union.

James F. Burke, business manager of Local 182, Boston, stated that "every one of our members is now employed, thus it would be foolish for us to agitate for jobs that we couldn't fill." The timing of the bombings at exactly the same hour in three different cities made the matter a feature story in newspapers throughout the East.

CARTOON USES 12,000 DRAWINGS, ALL HAND-COLORED

Production of the cartoon, "Once Upon a Lifetime," presented by the Metropolitan Life Insurance Co. to teach street safety, was marked by unique technical processes. The 12,000 drawings used to complete the film required the services of 15 animators and about 35 other artists over a period of several months.

When completed each of the 12,000 drawings were colored by hand, more than 100 different colored shades being utilized.

'IT CAN'T HAPPEN TO ME'

Fire starting in the projection room ruined the Ritz Theatre, Hickman, Ky. Damage amounted to $6,500. Several persons were injured in the wild rush for the exits.

TWO MILLION GET LOW-DOWN ON PROJECTION WORK

Projection was served up piping hot to the more than two million Sunday readers of the New York *Daily News* through the medium of a feature story therein the material for which was gathered in a tour of the N. Y. Paramount projection room by a *News* writer. The feature was was worked up by Harry Rubin, projection director for Paramount, and James J. Finn, editor of I. P. Excerpts from the story are appended hereto.—*Ed.*

GARBO earns a million dollars, supervisors, directors, magnates and other relatives earn more millions; fortunes are spent for sets and technicians and artificial eyelashes; staggering sums are spent on theatres with better carpets than the one in the living room—

And the net result—a movie—reaches its destination by being put into the hands of a man whom nobody sees or knows or hears of or cares about: the guy in the projection booth. Even when we see him picketing he doesn't strike us as a public character.

Some 6,000 men have each paid the city (N. Y.) $10 for licenses to operate movie projectors. Harry Rubin estimates that 1,500 of these are good men. Rubin, who's the big boss of all the projectionists on the Paramount-Publix chain, got his first operator's license in 1907, when the machine was turned by hand and they used to flash a sign: "One Minute While We Change Reels."

Film Break a Major Crime

It takes a man one minute and thirty seconds to change reels in any of the three huge projectors in the Paramount Theatre, which shoot their images to a screen 190 *feet away. In the case of a break in the film maybe it could be done quicker—but in its eight years of existence the Paramount has never had a film break while showing.*

Nor do other modern movie houses have breaks any more. Equipment has improved since the days when the operator used to hold his watch in the projector and flash the time on the screen right in the middle of the big Indian attack; and carefulness has increased, too. The one great crime a projectionist can commit is to have a white screen.

It is 10:59 *A. M. A buzzer sounds*

once. "Warning!" calls one man. The other stands by the lighted projector. The clock on the wall jumps a minute, a switch clicks and the big projector begins to purr. Far below and beyond the curtains part and the newsreel starts, on time. All week long the schedule never varies a minute from opening to closing time.

At 11:01 the buzzer sounds once. The man who called "Warning!" reaches to the front wall and turns a dial knob back a notch. A sound observer in the theatre has decided that the volume is too high. If it had been too low he'd have buzzed twice. The men in the steel booth can't guess what conditions are in the theatre. A full house takes more volume than a half-empty one. The screen, too, is so far away the projectionists use field glasses to determine if the focus is sharp.

The projectionist has come a long way up the technical ladder since the old hand-grinding days—but most of the men who were good operators then are good operators now. They must know electricity—like how many amperes a certain size wire will carry; they must know radio, for there are lots of tubes and things to fool with; they must know sound reproduction and keep the amplifiers in repair. They have to know the science of optics and be good mechanics enough to repair a delicate and complicated machine.

Film is rewound by hand, a projectionist running thumb and forefinger over every inch as it slithers by. It's quite a trick, feeling the film for cracked edges without cutting the finger or wearing callouses on them.

There are nine projectionists at the Paramount. Two men for each seven-hour shift, two shifts a day and a four-day week. Salaries aren't what they were when sound first came in, and any guy who knew anything was regarded as Merlin himself.

AYLESWORTH ON COLOR

"The next great step forward to retain audience interest, along with the necessary progress in a progressive field like motion pictures, will be the development of 'natural' or real color in motion pictures. I am of the opinion that 1935 will show distinct progress in this direction, and now that the 'bugs' are being eliminated in the color process, we will see a rapid development in the direction of color.

"Surely it will be the most progressive step taken in motion pictures since the change from silent to sound motion pictures."—*M. H. Aylesworth, president, RKO Corp.*

SWEET METRO PROFITS

The net profit of Metro-Goldwyn Pictures Corp. for the year ending August 31, 1934, was \$4.702.257.71, or almost three times as high as it was the previous year. In addition, the year saw a rise of four and one-half millions in assets.

The preferred stock earnings per share in 1934 were \$31.26.

ROXY PICKS HIGH FIDELITY

Warner Theatres. Inc., has installed an RCA High Fidelity sound picture system in the deluxe 4750-seat Roxy-Mastbaum theatre in Philadelphia. now operated by Roxy. Order also included an elaborate sound reenforcement system including 25 velocity microphones.

IN THE EDITOR'S MAIL

(*Continued from page* 12)

more articles along this line in the I. P.

SOUTHWEST THEATRE EQUIPMENT CO.
Wichita, Kansas.

[To which need be said only that it all depends upon what is considered "acceptable" projection. Based upon projection standards of today, it is incredible that even the best 16 mm. projector equipment can deliver results comparable in any way with even passable 35 mm. carbon arc projection. There is a wide difference between good and bad projection work, of course, but in any discussion of projection or equipment it is assumed that we are aiming at the optimum.—*Editor.*]

Single-Phase Rectifiers

In "The Suprex Carbon Arc" article in your last issue you state that single-phase rectifiers are not satisfactory for the new Suprex carbon lamps. Does this statement imply that the two types (filtered and unfiltered outputs) both are unsuitable for single-phase work?

May I suggest that a little information on this subject in an early issue would be greatly appreciated by many projectionists.

HAROLD W. WOTT
Oak Harbor, Ohio.

[This topic is discussed elsewhere in this issue by J. H. Elderkin under the title, "Single- and Polyphase Rectifiers for Projection."—*Editor.*]

TECHNICAL AND ECONOMIC ASPECTS OF SUPREX

(*Continued from page* 11)

is merely to make the mirror a little thicker.

MR. BRENKERT: Is the guard made in the same mould as the mirror? The focal length of the reflector is an important factor, and it would, of course, be impossible to put the guard in exactly the same plane as that of the original reflector.

MR. RUBIN: That does not matter; you simply focus the combination of mirror and guard. The fact is the Committee discovered that the focus was just as good with or without the guard. The loss of light was negligible; we couldn't measure it.

Committee Findings Correct

MR. SACHTLEBEN: These reflections do occur, but most of the light so reflected adds to the light coming from the mirror. In view of the theory of application of the guard, the findings of the Projection Practice Committee are perfectly acceptable.

MR. RICHARDSON: The Committee may have used a guard, the surface of which happened to fit exactly. There are about fifteen different mirrors on the market and they are not all made on one tool.

MR. BRENKERT: Elliptical reflectors are not ground and polished. In other words, they vary in focal length as well as in working distance, or both. It may be possible to make a few sufficiently accurately to superimpose one upon the other, but in production in large quantities I am afraid trouble will result. If you want satisfactory

results, in practice all over the country and not in only a few spots, I should prefer to match up the protector with the reflector. Unless the problem can be put to the mirror manufacturers I believe it is entirely out of the hands of the lamp manufacturer to control the accuracy of the reflector. I want to be clearly understood: I don't object to anything that is an improvement, but I do object to anything that is going to cause trouble.

Guards vs. Pitted Mirrors

President Goldsmith: It may be, of course, that extreme accuracy is not as necessary as we perhaps think. If the auxiliary guards are thin and if their surfaces are reasonably clean, then the major loss of light, of useful light, will result from absorption in the glass, rather than from reflection, and that necessarily will be fairly small in good clear glasses.

Mr. Rubin: The only question involved here is this: After a week or two of using the Suprex carbons, which pit considerably, will you get more light with the protector, which you claim causes a loss of 4 per cent, than from a pitted mirror? When you sell the exhibitor a mirror, he is not going to buy another one in two minutes. He will allow the mirror to become pitted more and more, for three weeks or a month, or perhaps a year. Which is to be preferred?

CODE A SALARY PICNIC

Operation of the Code Authority of the motion picture industry cost the business $181,498.30, according to recent official figures. More than $97,000 of the total went for salaries. Incidentally, John C. Flinn, secretary of the C. A., recently had his salary of $12,000 annually raised to $20,000.

Receipts from exhibitors were $88,798, while producers and distributors kicked in with $100,500.

NEW S. M. P. E. OFFICERS

Dr. A. N. Goldsmith will retire as president of the S. M. P. E. on December 31. He will be succeeded by H. G. Tasker, of the United Reproducer Corp. New members of the Board of Governors are S. K. Wolf and M. C. Batsel.

SMALL THEATRES HAVING LOW-INTENSITY ARCS

(Continued from page 7)

the following rules be strictly observed:

1. Both lamps should be adjusted to an equal load.
2. The gap between carbons should always be the same.
3. Whenever a new carbon trim is requires two or three minutes to build ciater should be allowed before the light is projected on the screen. Usually it requires two or three minutes to build an efficient crater on these low-intensity carbons.
4. All lamps and contacts should be checked for loose connections at regular and frequent intervals. Loose contacts are the cause of much unsteady and flickering lights.
5. Mirrors should be kept clean and protected from the arc flame when the arc is struck.

Improper striking of the arc is frequently the cause of poor light quality. Many projectionists just let the positive and the negative carbons touch, turn on the switch and let the current run through for several seconds before adjusting the gap. This method is wholly wrong in that it does not provide the necessary amount of resistance, ordinarily supplied by the arc flame, and effectively prevents the forming of an efficient crater.

Striking The Arc Correctly

The correct method of striking an arc is to *first* switch on the current while the carbons still are apart, then to bring them together for only a fraction of a second. This procedure will assure the formation of a good crater, as the carbons are overloaded for only a very short period.

It is also important that carbons be kept in an absolutely dry place in the projection room. Carbons absorb moisture very easily, and thus occasion an unsteady and sputtering light.

Lamphouse ventilation also deserves consideration. If there be too much draft, the arc flame will be affected and the light will be thrown out of focus. The reason for ventilating a lamphouse is to permit the escape of gases produced by the burning carbons and to permit the entrance of cool air into the lamphouse.

Future of L. I. Lamps

Low-intensity arc lamps still are used in the majority of theatres throughout the world. Skill and experience made it possible for carbon manufacturers to supply these theatres with a good light at low cost. Thousands of theatre owners and projectionists rely on the efficiency and dependability of existing low-intensity lamps.

While it is true that the recent development of new arc types has affected the low-intensity field, it is safe to say that it will be several years before existing low-intensity equipment is replaced in those theatres which are using the smaller carbon trims on low amperages.

This being the case, it is imperative that existing low-intensity equipment be afforded every opportunity to deliver the best possible results.